Ozone Impact Assessment

for

GASCO Energy Inc.
Uinta Basin Natural Gas Development Project
Environmental Impact Statement

Prepared for: Bureau of Land Management
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1.0 Introduction

Gasco Production Company (Gasco) has proposed to the United States Department of the Interior (USDOI) Bureau of Land Management (BLM) Vernal Field Office (VFO) to develop oil and natural gas resources within the Monument Butte, Red Wash and West Tavaputs Exploration and Development Areas. The project area is located within Uintah and Duchesne Counties, Utah and consists of approximately 187 sections located in Township 9 South, Ranges 18 and 19 East; Township 10 South, Ranges 14, 15, 16, 17 and 18 East; and Township 11 South, Ranges 14, 15, 16, 17, 18 and 19 East (Map 1).

Gasco operates the majority of the mineral lease rights underlying both the public and private lands in the project area. The project area encompasses approximately 206,826 acres predominantly in the West Tavaputs Exploration and Development Area with some overlap into the Monument Butte–Red Wash Exploration and Development Area of the Diamond Mountain Planning Area of the VFO. The project area includes lands within the restored exterior boundary of the Ute Indian Reservation, but no lands administered by the Tribe or by the Bureau of Indian Affairs. Targeted geologic strata lie in the Wasatch, Mesaverde, Blackhawk, Mancos, Dakota, and Green River formations, approximately 5,000–20,000 feet below the earth's surface.

1.1 Project Description

The Gasco Energy Inc. Uinta Basin Natural Gas Development Project (GASCO) Project Area is located 20 miles south-southwest of Roosevelt, Utah and covers 206,826 acres in an existing oil and gas producing region located in Duchesne and Uintah Counties, Utah. Surface ownership in the project area is 86% federal (managed by the Bureau of Land Management [BLM]), 12% State of Utah (managed by State of Utah School and Institutional Trust Lands Administration [SITLA]), and 2% private.

The GASCO Project Area currently contains active producing wells, with accompanying production related facilities, roads, and pipelines. Additional wells are proposed for development and are being considered under the Wilkin Ridge Environmental assessment (UT-080-2006-478).

Proposed wells would be drilled to recover gas reserves from the Wasatch, Mesa Verde, Blackhawk, Mancos, Dakota, and Green River Formations in the GASCO Project Area. The spacing of the wells will vary according to the geologic characteristics of the formation being developed; the densest spacing expected is one well pad per 40 acres.

The primary components of the Proposed Action that were utilized for the development of a project specific emissions inventory for this ozone assessment were based upon an updated development schedule developed by Gasco in April 2010. The Proposed Action primary components are as follows:

Up to 1,491 natural gas wells over a 15 year development period, 45 year life of project (LOP);

Up to 10 drilling rigs operating year round;

30 evaporative ponds with a total of 2,700-hp of electrical generation; and

Approximately 21,325 horsepower of compression would be added to the existing system, for a total of 27,940 horsepower (hp) within the Project Area.

Table 1-1 shows the summary of the emissions inventory for the Proposed Action.

Under the Proposed Action, the rate of development for new wells would increase gradually from project initiation until the year 2015 when the maximum proposed development rate is projected to be realized. It is anticipated that the maximum development rate of 120 new wells per year would be sustained between the years 2015 and 2018. After 2018 the planned rate of development is projected to decrease until full project development is accomplished in about the year 2015.

Emissions to the atmosphere from the proposed project would include the following criteria pollutants and precursors: nitrogen oxides (NO_x), particulates (PM_{10} and $PM_{2.5}$), Volatile Organic Compounds (VOC), and sulfur dioxide (SO_2). These pollutants would be emitted from the following activities and sources:

Well pad and road construction: equipment producing fugitive dust while moving and leveling earth, vehicles generating fugitive dust on access roads;

Drilling: vehicles generating fugitive dust on access roads, and drill rig engine exhaust;

Completion: vehicles generating fugitive dust on access roads, frac pump engine and generator emissions, and completion venting emissions;

Vehicle tailpipe emissions associated with all development phases;

Well production operations: three-phase separator emissions, flashing and breathing emissions from a condensate tank, fugitive dust and tailpipe emissions from pumpers and trucks transporting produced condensate and water from storage tanks;

Central production facility: compressor engines emissions, central glycol dehydration unit emissions, flare emissions for control of central facility VOC emissions, central flashing and breathing emissions from condensate tanks, and emissions associated with loading natural gas liquids (NGL) into trucks; and

Water Evaporation Facility: generator engine emissions and fugitive dust and tailpipe emissions from water trucks delivering produced water.

To reduce the emission of ozone forming precursors (NO_X and VOC) GASCO has committed to implement the following Applicant Committed Environmental Protection Measures (ACEPMs):

1. The use of Tier II or better diesel drill rig engines to reduce NO_X emissions;
2. RMP compliant NO_X emission limitations of 1.0 g/hp-hr for engines rated greater than 300 hp and 2.0 g/hp-hr for engines rated at 300 hp or less.
3. The installation of low-bleed pneumatic controls, where technically feasible, on all new separators to reduce potential VOC emissions;
4. To reduce current VOC emissions all existing high-bleed pneumatic controls within the project area will be replaced or retrofitted with low-bleed units where technical feasible;
5. The use of solar-powered chemical pumps (i.e. Methanol pumps) in place of VOC emitting pneumatic pumps at new facilities;

6. The use of centralized compression facilities (no well site compression) to minimize potential NO_X emissions;
7. The use of centralized dehydration, (no well site dehydration) to minimize potential VOC emissions;
8. The control of central facility stock tanks and glycol dehydrators to reduce potential VOC emissions by at least 95%.

The above ACEPMs would result in the reduction of 647 tons per year NO_X and 8,273 tons per year of VOC assuming the implementation of the Proposed Action. Larger or smaller emission reductions would occur as a result of the ACEPMs if other alternatives other than the Proposed Action were to be implemented.

This ozone impact analysis considered the emissions from the Proposed Action with and without applicant committed measures to reduce ozone precursor emissions.

Table 1-1. GASCO Alternative Emissions Comparisons					
Alternative	**Phase**	**Pollutant (ton/yr)**			
		NO_x	**CO**	**VOC**	**SO_2**
Proposed Action	Development	1,303	433	103	23
	Operations	580	437	9,820	1
	Total	***1,883***	***871***	***9,923***	***24***
Proposed Action with ACEPMs	Development	656	433	103	23
	Operations	580	437	1,551	1
	Total	**1,237**	**871**	**1,654**	**24**

1.2 Modeling Approach

For more than a decade, EPA has been developing the Models-3 Community Multiscale Air Quality (CMAQ) modeling system with the overarching aim of producing a 'One-Atmosphere' air quality modeling system capable of addressing ozone, particulate matter (PM), visibility and acid deposition within a common platform (Byun and Ching, 1999, Pleim et al., 2003, Byun and Schere, 2006). The original justification for the Models-3 development emerged from the challenges posed by the 1990 Clean Air Act Amendments and EPA's desire to develop an advanced modeling framework for 'holistic' environmental modeling utilizing state-of-science representations of atmospheric processes in a high performance computing environment. EPA completed the initial stage of development with Models-3 and released CMAQ in mid-1999 as the initial operating science model under the Models-3 framework. This study used CMAQ version 4.6, publicly released October 2006.

CMAQ consists of a core Chemical Transport Model (CTM) and several pre-processors including the Meteorological-Chemistry Interface Processor (MCIP), initial and boundary conditions processors (ICON and BCON) and a photolysis rates processor (JPROC). EPA continues to improve and develop new modules for the CMAQ model and typically provides a new release each year. In the past, EPA has also provided patches for CMAQ as errors are discovered and corrected. More recently, EPA has funded the Community Modeling and Analysis Systems (CMAS) center to support the coordination, update and distribution of the Models-3 system. Byun and Schere (2006) describe the newest features implemented in the previously released CMAQ version 4.5.

2.0 CMAQ Modeling

The CMAQ modeling system is used for assessing the potential ozone impacts of the GASCO project in the surrounding area. The CMAQ analysis consists of the following model simulations:

- Run 1 is the *2006 actual* year simulation using actual emissions and also is used in the model performance evaluation;
- Run 2 is the *2006 typical* year, which uses typical emissions instead of actual emissions, and is used for comparison with the future case design value calculations. The only difference between the *actual* and *typical* runs are that the *actual* run uses Continuous Emission Monitoring (CEM) data for point sources whereas the *typical* run has point sources operating at more typical permitted levels;
- Run 3 is a *future baseline* year, which is 2018 – the year the GASCO project is projected to have maximum development activities and emissions;
- Run 4 is the simulation that includes the 2018 future baseline year and the anticipated emissions for the GASCO project without applicant committed measures to reduce emissions;
- Run 5 is the simulation that includes the 2018 future baseline year and the anticipated emissions for GASCO including emissions reductions resulting from applicant committed measures;

The "GASCO project-only" impacts are estimated by determining the difference between Runs 4 and 3, and Runs 5 and 3, respectively.

The year 2006 is used for the CMAQ ozone modeling for the GASCO study. This selection is appropriate primarily because of data availability for 2006 from the IPAMS Uinta Basin Air Quality Study (UBAQS) and being a current year to take advantage of implementation of federal and local control programs.

The year 2018 was selected as the future baseline year based upon the predicted maximum development rate and associated emissions for the Gasco Proposed Action.

2.1 Modeling Domains

This section summarizes the model domain definitions for the GASCO ozone modeling, including the domain coverage, resolution, map projection, and nesting schemes for the high resolution sub-domain.

2.1.1 Horizontal Modeling Domain

Figure 2-1 displays the 36/12 km modeling domains that are used in the CMAQ/SMOKE air quality/emissions modeling. The 36-km continental United States (U.S.) horizontal domain for CMAQ air quality and SMOKE emissions modeling are identical to what is used by several Regional Planning Organizations (RPOs) for their regional haze modeling (e.g., WRAP, CENRAP and VISTAS). This 36-km modeling domain covers the continental U.S. as well as large portions of Mexico and Canada. The CMAQ 12-km modeling domain is shown in **Figure**

2-2 and covers eastern Utah, western Colorado and portions of Wyoming, Arizona and New Mexico.

The CMAQ air quality and SMOKE emissions modeling 36/12 km modeling domains are aligned within the MM5 domains. The larger MM5 modeling domains provide a buffer around the CMAQ/emissions modeling domains by at least 6 grid cells in each direction. These grids are based on a Lambert Conformal Projection (LCP) using the same projection as adopted by the RPOs. The LCP parameters are listed in **Table 2-1**.

There is a possibility of boundary "noise" effects resulting from boundary conditions coming into dynamic balance with the MM5 algorithms. The WRAP 12-km MM5 domain, with the 12-km CMAQ domain in red, is presented in **Figure 2-3**. The larger MM5 domain is designed to sequester such errors from the air quality simulation. The buffer region used in the current study exceeds the EPA suggestion of at least 5 grid cell buffers at each boundary.

Table 2-2 lists the number of rows and columns (i.e., the number of grid cells in the east-west and north-south direction) and the definition of the X and Y origin (i.e., the southwest corner) for the 36/12 km domains used in the CMAQ and the SMOKE models for the current study.

2.1.2 Vertical Modeling Structure

The CMAQ vertical structure is primarily defined by the vertical grid used in the MM5 modeling. The MM5 model employs a terrain-following coordinate system defined by pressure, using multiple layers that extend from the surface to 100 millibars (mb), which is approximately 15 km above ground level (AGL). A layer-averaging scheme is adopted for CMAQ simulations to reduce the air quality computational time. The effects of layer averaging were evaluated by WRAP and VISTAS and found to have a relatively minor effect on the model performance metrics when both 34 layer and 19 layer CMAQ model simulations were compared to ambient monitoring data (Morris et al., 2004a). For the GASCO ozone modeling, 19 vertical layers are used. **Table 2-3** lists the mapping from the MM5 vertical layer structure to the CMAQ vertical layers. This MM5 structure was taken from the WRAP, VISTAS and CENRAP RPO configuration and the same CMAQ structure is also being used in the RPO modeling. Note that the MM5 and CMAQ models both use a terrain following "sigma" coordinate system so over elevated terrain the model heights will be compressed.

2.2 Model Input Preparation Procedures

2.2.1 Meteorological Inputs

This and the following subsections describe the procedures used in developing the meteorological, emissions, and air quality inputs to the CMAQ model for the GASCO ozone modeling study on the 36/12 km grids. The development of the CMAQ meteorological and emissions inputs are discussed together with the science options recommended for the CMAQ model. The procedures for developing the initial and boundary conditions and photolysis rates are also discussed along with the model application procedures.

The procedures set forth here are consistent with EPA guidance (e.g., EPA, 1991; 1999; 2005a; 2007), other recent 8-hour ozone modeling studies conducted for various State and local agencies using these or other state-of-science modeling tools (e.g., Tesche et al., 2003; Morris et al., 2004a,b; Tesche et al., 2005a), as well as the methods used by EPA in support of the recent Clean Air Interstate Rule (EPA, 2005b) and the Clean Air Mercury Rule (EPA, 2005c).

Annual 36/12 km MM5 simulations for 2005 (McNally and Schewe 2006) and 2006 (McNally and Schewe, 2008) are used to provide meteorological inputs to the CMAQ and SMOKE models. The MM5 configuration is based on the WRAP 2002 simulation (Kemball-Cook et. al. 2004), which were based on an extensive review of available MM5 physical and dynamical options and have been the basis of many subsequent MM5 applications in the region. The WRAP did a fairly extensive study to determine the optimal configuration for the MM5 modeling system. One of the choices they made was to use the Betts-Miller Cumulus Parameterization. Betts-Miller was developed to parameterize tropical convection. However, using Betts-Miller improved the precipitation skill of the model.

2.2.2 Emission Inputs

In order to simulate atmospheric ozone levels, it is necessary to develop emissions estimates for all other emission sources (i.e., industrial, electric generation, motor vehicle, biogenic) in addition to the emissions from the Gasco project. The foundation datasets for the emissions development are based on the emissions data developed by the Western Regional Air Partnership (WRAP). Details on the emissions input preparation are presented in Chapter 3.0. The emissions are processed into CMAQ-ready files using SMOKE 2.4 for both the 36- and 12-km grids. SMOKE 2.4 is used because several of the WRAP-developed emissions files are not directly compatible with the newest version of SMOKE (i.e., Version 2.6). Further, this project would not have benefited from the enhancements in SMOKE Version 2.6.

2.2.3 CMAQ Science and Input Configurations

This section describes the model configuration and science options to be used in the GASCO ozone modeling effort. **Table 2-4** summarizes the CMAQ configuration that was used in the study. The latest version of CMAQ (Version 4.6) was used in the GASCO ozone modeling.

As indicated in the CMAQ model setup defined in **Table 2-4**, two grids were employed. CMAQ was initially run for the 2006 base case on the 36-km continental U.S. grid for calendar year 2006. CMAQ was then run for the 2006 base case on the 12-km grid utilizing the initial and boundary conditions from the 36-km CMAQ simulation.

CMAQ inputs were as follows:

> Meteorological Inputs: The MM5-derived meteorological fields were prepared for CMAQ using MCIP 3.3.
>
> Initial/Boundary Conditions (IC/BC's): The IC/BC's for the 36-km continental U.S. simulation were based on the latest available information. Currently, the RPOs use

IC/BC's for the same domain based on a 2002 GEOS-CHEM global chemistry model simulation. Boundary and initial conditions for the 12-km nest will be generated from the 36-km CMAQ nest using the CMAQ ICON and BCON processors.

<u>Photolysis Rates:</u> The modeling team prepared the photolysis inputs as well as the albedo/haze/ozone/snow inputs for CMAQ based on Total Ozone Mapping Spectrometer (TOMS) data using the CMAQ JPROC processor.

<u>Spin-Up Initialization:</u> The model was run in quarters using a nominal 15-day spin-up from the previous quarter for the 36-km grid and a nominal 4 day spin-up from the previous quarter for the 12-km grid.

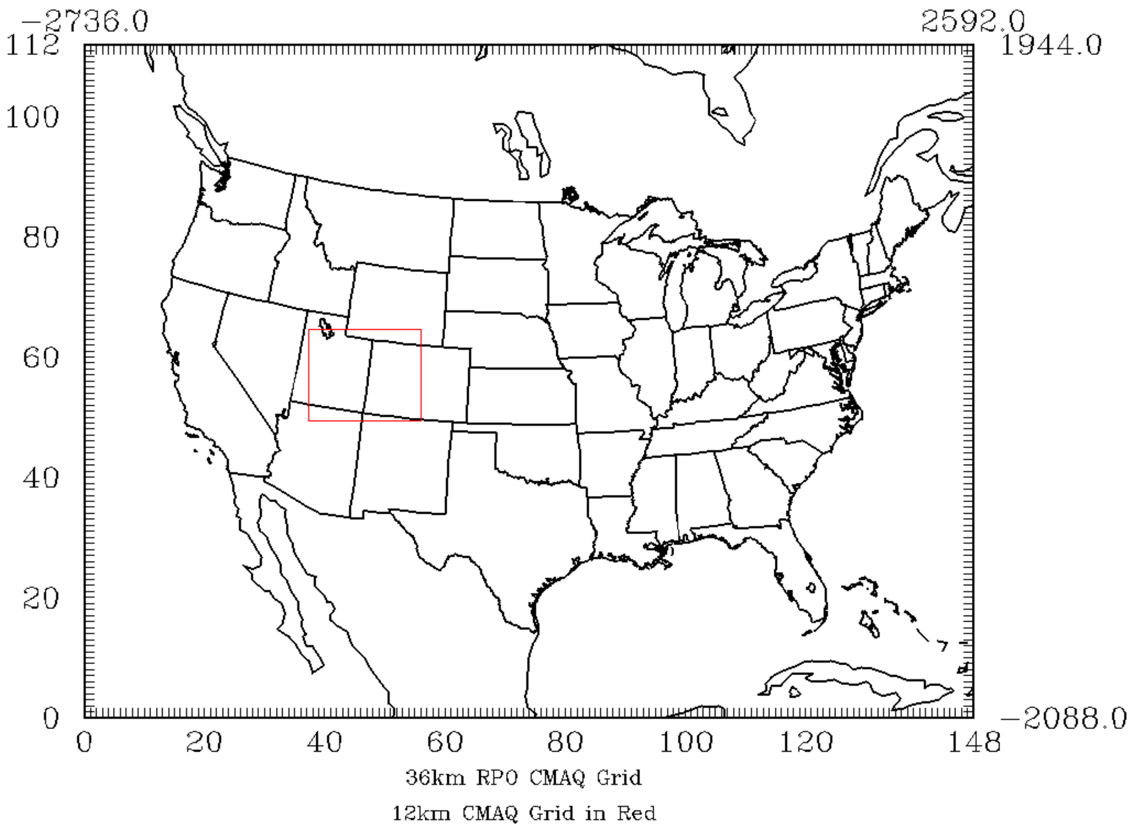


Figure 2-1. 36- and 12-km CMAQ Domains for GASCO Study. The 12-km domain is highlighted in red and is expanded in Figure 2-2.

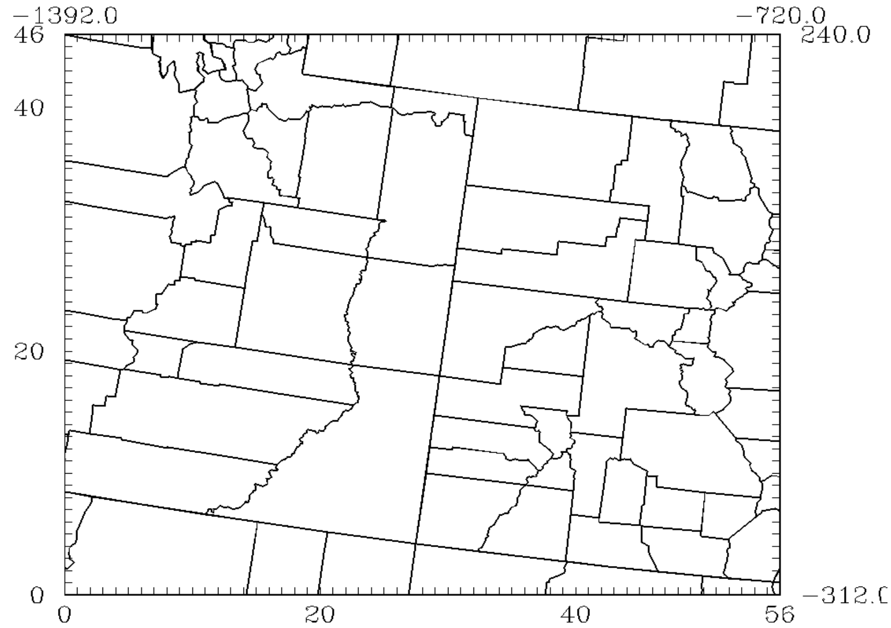


Figure 2-2. 12-km CMAQ Domain for GASCO Study.

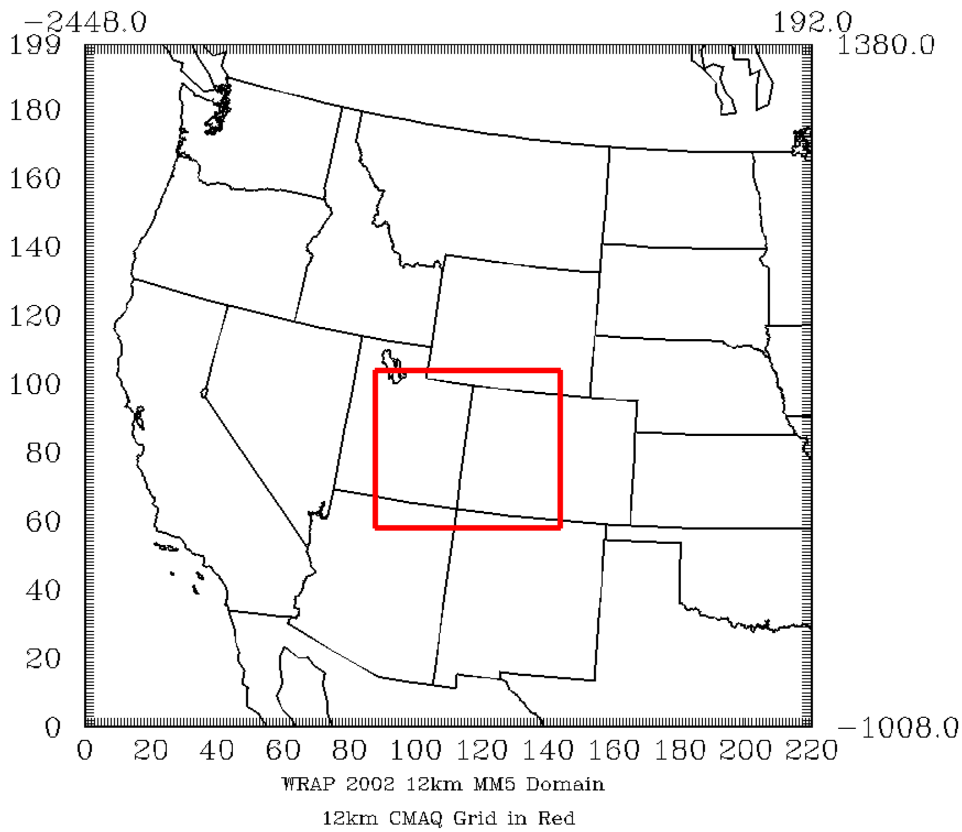


Figure 2-3. 12-km WRAP MM5 Domain with 12-km CMAQ Domain for GASCO Study

Table 2-1. Lambert Conformal Projection (LCP) Definition for the GASCO Modeling Grid	
Parameter	**Value**
Projection	Lambert-Conformal
1st True Latitude	33 degrees N
2nd True Latitude	45 degrees N
Central Longitude	-97 degrees W
Central Latitude	40 degrees N

Table 2-2. Grid Definitions for SMOKE and CMAQ				
Grid Resolution	**east-west grid cells**	**north-south grid cells**	**X-origin (km)**	**Y-origin (km)**
36-km grid	148	112	-2736.0	-2088.0
12-km grid	53	47	-1368.0	-288.0

Table 2-3. Vertical Layer Definition for MM5 Simulations (left most columns), and Approach for Reducing CMAQ Layers by Collapsing Multiple MM5 Layers (right columns)								
MM5					**CMAQ**			
Layer	**Sigma**	**Pres (mb)**	**Height (m)**	**Depth (m)**	**Layer**	**Pres (mb)**	**Height (m)**	**Depth (m)**
34 (top)	0.000	100	18123	2856	19	100	18123	9160
33	0.050	145	15267	2097				
32	0.100	190	13170	1659				
31	0.150	235	11510	1374				
30	0.200	280	10136	1173				
39	0.250	325	8963	1024	18	325	8963	3492
28	0.300	370	7938	909				
27	0.350	415	7030	817				
26	0.400	460	6213	742				
25	0.450	505	5471	680	17	505	5471	1890
24	0.500	550	4791	627				
23	0.550	595	4163	582				
22	0.600	640	3581	543	16	640	3581	1053
21	0.650	685	3038	509				
20	0.700	730	2528	386	15	730	2528	664
19	0.740	766	2142	278				
18	0.770	793	1864	269	14	793	1864	443
17	0.800	820	1596	174				
16	0.820	838	1421	171	13	838	1421	338
15	0.840	856	1251	167				
14	0.860	874	1083	164	12	874	1083	163
13	0.880	892	920	161	11	892	920	161
12	0.900	910	759	79	10	910	759	158
11	0.910	919	680	78				
10	0.920	928	601	78	9	928	601	155
9	0.930	937	524	77				
8	0.940	946	447	76	8	946	447	76
7	0.950	955	371	75	7	955	371	76
6	0.960	964	295	75	6	964	295	75
5	0.970	973	220	74	5	973	220	74
4	0.980	982	146	37	4	982	146	37
3	0.985	987	109	37	3	987	109	37
2	0.990	991	73	36	2	991	73	36
1	0.995	996	36	36	1	996	36	36
0 (ground)	1.000	1000	0	0	0	0	0	0

Table 2-4. CMAQ (version 4.6) Model Configuration		
Science Options	**Configuration**	**Details/Comments**
Model Code	CMAQ (version 4.6)	Pleim et al., (2003)
Horizontal Grid Mesh	36/12 km	36-km covering continental U.S; 12-km covering Eastern UT and Western CO
36-km grid	148 x 112 cells	RPO National Grid
12-km grid	53 x 47 cells	
Vertical Grid Mesh	19 Layers	First 8 layers synchronized with MM5
Grid Interaction	One-way nesting	
Initial Conditions	15 days full spin-up	Separately run 4 quarters of 2002
Boundary Conditions	GEOS-CHEM annual run	2002 GEOS-CHEM run.
Emissions		
Baseline Emissions Processing	See SMOKE (Ver 2.4) model configuration	MM5 Meteorology input to SMOKE, CMAQ
Dust Transport Fraction	Applied in emissions before SMOKE	
NH3 Inventory Adjustment	Applied in emissions before SMOKE	
Sub-grid-scale Plumes	No Plume-in-Grid (PinG)	
Chemistry		
Gas Phase Chemistry	CBM-IV	with Isoprene updates
Aerosol Chemistry	AE3/ISORROPIA	
Secondary Organic Aerosols	Secondary Organic Aerosol Model (SORGAM)	Schell et al., (2001)
Aerosol Mass Conservation Patch	Yes	
Cloud Chemistry	RADM-type aqueous chemistry	Includes subgrid cloud processes
N2O5 Reaction Probability	0.01 – 0.001	
Horizontal Transport		
Eddy Diffusivity Scheme	K-theory with K_h grid size dependence	Multiscale Smagorinsky (1963) approach
Vertical Transport		
Eddy Diffusivity Scheme	K-theory	
Diffusivity Lower Limit	Kzmin = 0.1	
Planetary Boundary Layer	No Patch [1]	
Deposition Scheme	M3dry	Directly linked to Pleim-Xiu Land Surface Model parameters

Table 2-4. CMAQ (version 4.6) Model Configuration		
Science Options	**Configuration**	**Details/Comments**
Numerics		
Gas Phase Chemistry Solver	Euler Backward Iterative (EBI) solver	Hertel et al (1993) EPI solver ~ 2x faster than MEBI
Horizontal Advection Scheme	Piecewise Parabolic Method (PPM) scheme	
Other		
Meteorological Processor	MCIP ver 3-3	
Simulation Periods	Annual 2005/2006	
Integration Time Step	Internally Computed	15 minute coupling time step
Time zone	GMT	
Platform	Dual Processor/Quad Core Intel Xeon	
Run-Time (expected)	7-10 days	Platform Dependent

[1]PATCH means applying a mosaic scheme based on land-use, which is not normally done for CMAQ. The terminology is not the same as used for a software fix.

3.0 CMAQ Emissions Input Procedures

The emissions inventories utilized for the GASCO Study were based on several sources. The ozone modeling required CMAQ-ready emissions estimates for 2006 and an additional future modeling year. 2018 was selected as the future year modeling inventory because it coincided with the projected Proposed Action maximum development activity and emissions rates.

3.1 2006 and 2018 Emissions Inventory Sources

Air emissions inventories are developed from the WRAP emissions inventories. The WRAP inventories are compiled using data provided by state and tribal regulatory agencies, as well as industry partners, and include data for point, area, non-road mobile, and on-road mobile sources. All or portions of five different WRAP inventories are used to develop emissions for the 2006 Baseline and 2018 Projected Baseline scenarios. These WRAP inventories include:

- 2002 Plan2D – Baseline 2002 WRAP inventory for area, point, on-road and non-road mobile source;
- 2018 PRP18a – original WRAP forecasted inventory for non-road mobile and on-road mobile sources;
- 2018 PRP18b – updated WRAP forecasted inventory for point and area sources;
- 2006 Phase III – 2006 base year inventory for oil and gas sources within the Uinta and Piceance basins only; and
- 2012 Phase III – 2012 forecasted inventory for oil and gas sources.

A summary of the emissions datasets used for each emissions source category is included in Table 3-1.

Table 3-1. Summary of 2006 and 2018 Emissions Inventory Data Sources.

Emissions Source Category	Inventory Used for 2005/2006 Baseline	Inventory Used for 2018 Projected Baseline
Oil and Gas – Uinta Basin	WRAP Oil and Gas Phase III 2006	Projected from WRAP Phase III Oil and Gas 2006 based on projected cumulative activity in 2018
Oil and Gas – Piceance Basin	WRAP Oil and Gas Phase III 2006	Projected from WRAP Phase III Oil and Gas 2006 and 2012
Oil and Gas – Southwest WY	Wyoming 5-County (SWWY) 2005/2006 O&G Inventory	Wyoming 5-County (SWWY) 2005/2006 O&G Inventory with projections
Point Sources – Non Oil and Gas	Interpolated from WRAP 2002 Plan 2D and WRAP 2018 PRP 18a +Denver SIP	WRAP 2018 PRP18b
Area Sources – Non Oil and Gas	Interpolated from WRAP 2002 Plan 2D and WRAP 2018 PRP 18a + Denver SIP	WRAP 2018 PRP 18b
Non-Road Motor Vehicle	Interpolated from WRAP 2002 Plan 2D and WRAP 2018 PRP 18a +Denver SIP	WRAP 2018 PRP 18a
On-Road Motor Vehicle	Calculated with 2005 and 2006 meteorology and Interpolated VMT from WRAP 2002 Plan 2D and WRAP 2018 PRP 18a	Calculated with 2005 and 2006 Meteorology and WRAP 2018 PRP 18a VMT
Biogenic	MEGAN with 2005/2006 meteorology	MEGAN with 2005/2006 meteorology (held steady from 2005/2006)
Wildfire	2005/2006 Wildfire Inventory	2005/2006 Wildfire Inventory (held steady from 2005/2006)

3.1.1 2006 Baseline Inventory

The 2006 Baseline CMAQ-ready emissions were developed from the WRAP2002 Plan2d and WRAP 2018 PRP18a inventory using the same methodology as followed for the UBAQS project. (Morris et al., 2009). For the 2006 Baseline, the draft 2006 WRAP Phase III oil and gas emissions for the Piceance and Uinta basins are used. For Wyoming, the 2006 Southwest Wyoming (also referred to as the 5-County) oil and gas inventory was used. (WDEQ, 2008). For the area, non-road, and non-Continuous Emission Monitor (CEM) point source emissions, the emission rates are directly interpolated from the 2002 and 2018 values. The 2006 on-road motor vehicle emissions are calculated using vehicle miles traveled (VMT) values interpolated from the 2002 and 2018 VMT totals combined with mobile source emissions factors and meteorological data specific for the 2006 episode. Day-specific emissions for the 2006 episodes are obtained for the CEM point sources and fire emissions and are calculated for the biogenic emissions. For all source categories in Colorado, the WRAP emissions were replaced by the 2006 emissions inventories developed for the Denver State Implementation Plan. (Morris, 2007)

3.1.2 2018 Future Year Inventory

The 2018 future year emissions estimates were based mainly on the WRAP 2018PRPa and PRPb inventories. (ERG, 2009) For non oil and gas related sources, the predicted emissions for the 2018 forecast year for non-road and on road mobile sources are directly from the WRAP 2018PRP18a inventory. The WRAP 2018PRPb inventory update was incorporated for area sources and point sources. Fire and biogenic source categories were maintained at 2006 levels, which is consistent with the WRAP Phase II 2018PRP18a development approach.

The Oil and Gas (O&G) portions of the 2018 future year emissions projections were done on a regionally specific basis, with the Uinta Basin, Piceance Basin, Wyoming 5-County region, and other Colorado (outside the Piceance Basin) emissions handled separately.

Colorado O&G sources outside the Piceance Basin were calculated using the same inventory growth and controls as used in the future year inventories developed for the Denver SIP. (Morris, 2009).

Emissions projection factors for the Wyoming 5-County O&G emissions have not been developed by the Wyoming DEQ, but large portions of the regions are covered by emissions offset requirements for new development. To accommodate these offset requirements, the 2018 5-County inventory was held to 2006 levels, with the exception of the vehicular traffic emissions required for well maintenance and support. The growth in well counts for this area was assumed to be in proportion to other active drilling areas (Piceance and Uinta basins) and the traffic emissions were grown accordingly.

In the Piceance basin the 2018 oil and gas emissions were estimated by developing a growth rate from the 2006 and 2012 WRAP III estimates for the basin, applying the growth rates by county and SCC code, and then accounting for control measures being adopted in Colorado. (Bar-Ilan, 2009a).

Table 3-2. Projection Parameter Data for Piceance Basin.

SCC	Description	Projection Parameter	Projection Factor
2310000100	Heaters	total well count	2.391
2310000220	Drill rigs	Spuds	1.686
2310000230	Workover rigs	total well count	2.391
2310000300	Pneumatic devices	Conv. Gas Well Count	2.391
2310000700	Unpermitted Fugitives	total well count	2.391
2310000801	Gas Well Truck Loading	Condensate Production	2.096
2310000802	Oil Well Truck Loading	Oil Well Oil Production	1.000
2310000820	Gas Plant Truck Loading	Condensate Production	2.096
2310001610	Venting - initial completions	Spuds	1.686
2310001620	Venting - recompletions	Spuds	1.686
2310001630	Venting - blowdowns	total gas production	2.476
2310002230	Condensate tank	Condensate Production	2.096
2310002240	Oil Tank	Oil Well Oil Production	1.000
2310003100	Exempt engines	total well count	2.391
2310003200	Pneumatic pumps	total well count	2.391
2310003500	Flaring	total gas production	2.476
20200201	Compressor Engines	total gas production	2.476
20200202	Compressor Engines	total gas production	2.476
20200203	Compressor Engines	total gas production	2.476
20200252	Compressor Engines	total gas production	2.476
20200253	Compressor Engines	total gas production	2.476
20200254	Compressor Engines	total gas production	2.476
31000101	Permitted Fugitives	total oil production	0.810
31000102	Oil Production, Miscellaneous Well: General	total oil production	0.810
31000123	Oil Production, Well Casing Vents	total oil production	0.810
31000130	Oil Production, Fugitives: Compressor Seals	total oil production	0.810
31000132	Oil Production, Atmospheric Wash Tank: Flashing Loss	total oil production	0.810
31000199	Oil Production, Processing Operations: Not Classified	total oil production	0.810
31000201	Natural Gas Production, Gas Sweetening	total gas production	2.476
31000202	Natural Gas Production, Gas Stripping Operations	total gas production	2.476
31000203	Compressor Engines	total gas production	2.476
31000205	Natural Gas Production, Flares	total gas production	2.476
31000207	Permitted Fugitives	total gas production	2.476
31000209	Natural Gas Production, Incinerators	total gas production	2.476
31000215	Natural Gas Production, Flares Combusting Gases >1000 BTU/scf	total gas production	2.476
31000216	Natural Gas Production, Flares Combusting Gases <1000 BTU/scf	total gas production	2.476
31000220	Natural Gas Production, All Equipt Leak Fugitives	total gas production	2.476
31000225	Natural Gas Production, Compressor Seals	total gas production	2.476
31000227	Glycol Dehydrator	total gas production	2.476
31000228	Glycol Dehydrator	total gas production	2.476
31000230	Natural Gas Production, Hydrocarbon Skimmer	total gas production	2.476

Table 3-2. Projection Parameter Data for Piceance Basin.			
SCC	Description	Projection Parameter	Projection Factor
31000299	Natural Gas Production, Other Not Classified	total gas production	2.476
31000301	Glycol Dehydrator	total gas production	2.476
31000302	Glycol Dehydrator	total gas production	2.476
31000303	Glycol Dehydrator	total gas production	2.476
31000304	Glycol Dehydrator	total gas production	2.476
31000305	Natural Gas Processing Facilities, Gas Sweeting: Amine Process	total gas production	2.476
31000306	Natural Gas Processing Facilities, Process Valves	total gas production	2.476
31000309	Natural Gas Processing Facilities, Compressor Seals	total gas production	2.476
31000311	Natural Gas Processing Facilities, Flanges and Connections	total gas production	2.476
31000404	Process Heaters	total well count	2.391
31000405	Process Heaters	total well count	2.391
31000406	Process Heaters	total well count	2.391
31000502	Liquid Separator	total well count	2.391
31088801	Permitted Fugitives	total gas production	2.476
31088803	Permitted Fugitives	total gas production	2.476
31088804	Permitted Fugitives	total gas production	2.476
31088805	Permitted Fugitives	total gas production	2.476
31088811	Permitted Fugitives	total gas production	2.476
40400311	Tank Losses	total oil production	0.810
40400322	Tank Losses	total oil production	0.810

In the Uinta basin, the 2018 oil and gas emissions are projected based on predicted growth in key operating activity parameters by county from 2006 to 2018. (Bar-Ilan, 2009b) These growth rates are applied to specific oil and gas sources by Source Classification Codes (SCC) and control efficiencies are applied for control measures being adopted by operators under federal rule or consent decree.

3.1.3 Projected Activity Parameters and 2018 Scaling Ratios in the Uinta Basin

The 2018 projected baseline is estimated based on the growth of five operating parameters in each of the five counties within the Uinta Basin. The level of each of these parameters is based on the reasonably foreseeable development demonstrated by pending or proposed projects filed with the Bureau of Land Management.

These projects and associated well counts are summarized in Table 3-3. These parameters include:

- Total well count – total number of operating wells for all operators in each county;
- Spud count – number of wells drilled by all operators in each county;
- Total gas production – total gas produced by all operators in each county;
- Total condensate production – total condensate produced by all operators in each county; and
- Total oil production – total oil produced by all operators in each county.

Table 3-3. Summary of New Well Development for Proposed Projects in the Uinta Basin				
	Proposed Natural Gas Wells by 2018	Uinta County	Duchesne County	Carbon County
Anadarko Greater Natural Buttes EIS	3,675	3,675	--	--
BBC West Tavaputs Plateau EIS	807	20	23	764
Berry Petroleum ANF South Unit EIS	140	--	140	--
Enduring Resources Big Pack EA	490	490	--	--
Enduring Resources Southam Canyon EA	225	25	--	--
EOG Greater Chapita Wells EIS	3,725	3,725	--	--
EOG North Alger EA	44	44	--	--
Gasco Uinta Basin EIS	900	301	599	--
Newfield Monument Buttes EIS	700	272	428	--
XTO Hill Creek Unit EA	144	144	--	--
XTO Little Canyon EA	510	510	--	--
XTO River Bend Unit Infill EA	484	484	--	--

In reviewing proposed projects, no reasonably foreseeable future development is anticipated for Grand or Emery counties; therefore, these counties will be maintained at their 2006 uncontrolled emissions levels for the purposes of this analysis. Uncontrolled emissions of criteria pollutants for 2018 are calculated for each source category as the product of the 2006 emissions and the ratio of 2018 predicted activity level to the historic 2006 level for that parameter. The list of the source categories and the relevant activity parameter are summarized in Table 3-3. New development for the Gasco Uinta Basin is calculated in the project specific alternatives, and therefore the Gasco Uinta Basin well data is not included in the 2018 projection calculations.

A control efficiency is applied to the predicted uncontrolled emissions for certain source categories based on implementation of more stringent federal emission standards or installation of additional controls required by consent decree. Determination of these control efficiencies is discussed in detail in Section 3.1.4.

Table 3-4. Activity Parameters Used for Emissions Scaling by Source Category Code		
SCC	Description	Scaling Parameter
2310000100	Heaters	Total well count
2310000220	Drill rigs	Spud count
2310000230	Workover rigs	Total well count
2310000300	Pneumatic devices	Total well count
2310000330	Artificial lift	Total oil production
2310000700	Unpermitted fugitives	Total well count
2310000800	Truck loading of condensate	Total condensate production
2310000801	Truck loading of oil	Total oil production
2310000820	Gas plant truck loading	Total condensate production

2310001610	Venting - initial completions	Spud count
2310001611	Initial completion flaring	Spud count
2310001620	Venting - recompletions	Spud count
2310001630	Venting - blowdowns	Total gas production
2310001640	Venting - compressor startup	Total gas production
2310001650	Venting - compressor shutdown	Total gas production
2310002230	Condensate tank	Total condensate production
2310002231	Condensate tank flaring	Total condensate production
2310002240	Oil tank	Total oil production
2310003100	Miscellaneous engines	Total well count
2310003200	Pneumatic pumps	Total well count
2310020600	Compressor engines	Total gas production
2310021410	Dehydrator	Total gas production
2310021411	Dehydrator Flaring	Total gas production

Additional conventional well counts are taken from the proposed projects listed in Table 3-1 and are spatially allocated to each county on an annual basis based on the fraction of the project area in each county and the estimated start date, drilling rate, and schedule. This information was taken from pending EA or EIS documents for each project and is accumulated with recorded total well counts for each county for 2009 from the IHS, Inc. Exploration and Production Information database

Spud counts are estimated based on the change in total wells (conventional and CBM) from 2017 to 2018 in each county. An additional 5 percent spud to well rate is assumed to account for unsuccessful holes and ancillary drilling activities including monitoring and injection wells.

Gas production in 2018 from each county is predicted using a county-specific estimated well production decline over time. The number of wells at each given age is estimated as the number of new wells in each year based on projected and historical data. Gas production in each year is the product of the number of new wells and the assigned gas production rate for a well of that age; the total 2018 gas production is the sum of these products. For year 2018, only one half of the incremental production is considered due year round drilling and completion schedules.

For Uintah and Duchesne counties, condensate production in 2018 is predicted using a county-specific estimated well condensate production decline over time. The number of wells at each given age is estimated as the number of new wells in each year based on projected and historical data. Condensate production in each year is the product of the number of new wells and the condensate production for a well of that age; the total 2018 gas production is the sum of these products. For year 2018, only one-half of the production is considered due to well completion. For Carbon County, condensate production data was not available. Therefore, condensate production in Carbon County is predicted based on the historical ratio of the change in condensate production to the change in gas production of 0.0012.

The Newfield Monument Butte EIS indicates there will be 3,250 oil wells installed in Uintah and Duchesne counties over the life of the project; however, no data are available to predict oil production based on well schedule. Therefore, oil production in these counties is linearly forecast based on historical data. For each county, the linear increase is based on the growth rate from the last upturn in production (2001 for Uintah County and 2002 for Duchesne County). Projected oil production for the remaining counties in the Uinta Basin is held at their 2006 levels

Table 3-5 summarizes the historical 2006 activity parameter data and the projected 2018 activity levels. The ratio of 2018 to 2006 levels is used to develop a scaling ratio for uncontrolled emissions to predict 2018 emissions by source category for each county.

Table 3-5. Summary of Projection Parameter Data in Uinta Basin.

	Well Count			Spud Count			Total Gas Production		
County	**2006**	**2018**	**Ratio**	**2006**	**2018**	**Ratio**	**2006**	**2018**	**Ratio**
Uinta	4,035	12,207	3.03	685	677	.99	203,391	595,651	2.93
Carbon	730	1,615	2.21	58	0	0	20,497	121,803	5.94
Duchesne	1474	2,981	2.02	277	156	.56	22,526	40,025	1.77
Grand	368	368	1	27	27	1	6855	6,855	1
Emery	56	56	1	23	23	1	951	951	1

Table 3-5 Continued. Summary of Projection Parameter Data in Uinta Basin.

	Total Condensate Production			Total Oil Production		
County	**2006**	**2018**	**Ratio**	**2006**	**2018**	**Ratio**
Uinta	1,554	5,842	3.76	3,399	4,828	1.42
Carbon	43	148	3.43	0.3	0.3	1
Duchesne	163	455	2.79	6,402	15,093	2.36
Grand	9	9	1	116	116	1
Emery	4	4	1	4	4	1

3.1.4 Baseline Emissions Control Efficiency from Federal Rule and Consent Decree

Several existing federal rules will require more stringent emission standards on existing sources. Furthermore, some operators have entered into consent decrees with the U.S. Department of Justice that require them to install additional controls. This analysis reviewed and determined emissions reductions to baseline emissions for selected source categories based on these rules or agreements. For rules that affect only new sources, these controls are applied only to the portion of emissions above 2006 levels. Control efficiencies derived from retroactive rules or requirements are applied to all emissions for the relevant source category.

Federally enforceable emissions reductions occur with the stationary and nonroad engine requirements under 40 CFR Part 60, Subpart JJJJ and 40 CFR 89, respectively. VOC reductions from dehydrators at area sources under 40 CFR Part 63, Subpart HH are not likely to be required since these standards apply to area sources with a gas throughput of 3 MMscf/day. Based on the decline curve, the average production of a new well under the proposed project is 215 MMscf/yr (0.59 MMscf/day). Therefore, there is no expected applicability or enforceability of these reductions at area sources, and thus, reductions from this rule are not considered.

The U.S. District Court recently entered into the following 3 Consent Decrees with 7 operators in the Uinta Basin requiring controls on selected dehydrators, compressor engines, selected condensate tanks, and pneumatic devices:

• U.S. v. Wind River Resources Corporation and Bill Barrett Corporation;
• U.S. v. Dominion Exploration and Production, Inc. and XTO Energy, Inc.; and
• U.S. v. Miller, Dyer, & Co., LLC, Chicago Energy Associates, and Whiting Oil and Gas Corporation.

The only requirement under these consent decrees to have measurable and enforceable impact to baseline emissions is the installation of low-bleed pneumatics. Since low bleed pneumatics reduce the maximum release of actuating gas by 50 percent or more, emissions of VOC are assumed to be reduced by 50 percent for this source category. The total control efficiency for a county for pneumatic controls and devices is then calculated as the product of this 50 percent control and the fraction of operator control of future assets.

3.1.5 Summary of Emissions Inventory Data

The results of the emissions inventory 2006 base year and 2018 future year development are summarized by major source category in Table 3-6. These totals are average day emissions, before temporal adjustments are applied. The totals are over the 12-km modeling domain only.

Table 3-6. 12-km Emissions Modeling Domain Grid Totals.
Average Tons/day

Source Category	2018 Emissions Totals			2006 Emissions Totals		
	CO	NOx	VOC	CO	NOx	VOC
Area	211.3	31.1	264.3	93.3	17.5	113.5
NonRoad	574.4	31.4	85.2	775.0	102.8	83.5
Motor Vehicle	1787.0	70.0	69.0	2587.9	192.7	143.6
Point	362.8	505.4	120.3	225.2	662.6	50.6
Total Non-O&G	2935.5	637.9	538.8	3681.3	975.6	391.2
Piceance Basin O&G	11.0	10.0	42.0	0.2	17.3	59.7
Uinta Basin O&G	29.0	38.0	531.0	23.9	28.8	192.0
SWWY O&G	8.4	22.5	347.5	8.2	22.4	347.4
Other O&G	68.3	94.2	279.1	21.1	33.0	38.7
Total O&G	116.7	164.7	1199.6	53.4	101.5	637.8
Total	3052.2	802.6	1738.4	3734.7	1077.1	1029.0

3.2 Development of CMAQ Ready Emissions Inventories

Emissions inventory development for CMAQ ozone and haze modeling addressed several source categories including: (a) stationary point sources, (b) area sources, (c) on-road mobile sources, (d) non-road mobile sources, (e) biogenic sources and (f) fire sources. For this analysis, CMAQ ready emissions input files were created using SMOKE 2.4 for the 2006 and 2018 annual periods over the 36- and 12-km grids.

CMAQ requires emission input files containing hourly emission estimates, distributed both vertically and horizontally in the modeling domain. For ozone modeling alone, hourly emissions are required for NO, NO_2, CO, several classes of VOCs and other chemicals as available. The VOC classes used depend upon the chemical mechanism selected, which for the current study was CB-05 with updates to the isoprene chemistry.

CMAQ was also configured to provide particulate matter (PM) estimates, as well as visibility and deposition results. Thus, additional PM precursor species were needed as emissions inputs, which included SO_2, NH_3, SO_4, NO_3, EC, OMC, other primary $PM_{2.5}$ and coarse PM ($PM_{2.5\text{-}10}$).

3.3 Set-up of SMOKE for the GASCO Domain

SMOKE was configured to generate point, area, non-road, highway, and biogenic source emissions. In addition, certain subcategories, such as fires and electricity generator units (EGU) were maintained in separate source category files in order to allow maximum flexibility in producing alternate emissions modeling strategies. Domain specific oil and gas-related emissions were also maintained as a separate source category. With the exception of biogenic and highway mobile source emissions, that were generated using the MEGAN and MOBILE6 modules in SMOKE, respectively, pre-computed annual emissions were processed using the month, day, and hour-specific temporal profiles of the SMOKE model.

Producing 365 day-specific input files for all source categories places a burden on available computing facilities, data management systems, and would adversely affect the project schedule. Selecting representative model days for some or all of the source categories reduces the processing and file handling requirements to a more manageable level, and in most cases, does not compromise the accuracy of the emissions files. Other current or recent projects undertaken by EPA, WRAP and LADCO have used representative weekday/Saturday/Sunday emissions estimates for all source categories except biogenics either for each month or each season to model.

In an attempt to better represent the level of temporal and spatial detail available for each source category, a more detailed strategy was adopted. Biogenic emissions were modeled for each episode day, using the daily meteorology. Point sources, including CEM and fire emissions, were modeled for each episode day to take advantage of the available day-specific emissions and meteorology. All sources were treated by SMOKE as potentially elevated. No plume-in-grid sources were modeled. Wildfire emissions were handled as point sources. In the past, wildfire emissions were often handled as area source releases. However, since wildfires do have plume rise, techniques have been developed using plume rise calculations to place emissions into appropriate vertical layers. This technique was used in the WRAP and VISTAS CMAQ modeling.

Area sources, including non-road mobile and dust emissions, which do not utilize meteorological data, were temporally allocated by monthly, daily and hourly profiles that are contained in SMOKE. Review of these temporal profiles indicated that maximum temporal definition was achieved by selecting representative Thursday, Friday, Saturday, Sunday and Monday profiles for each month. Though motor vehicle emissions are influenced by meteorological variability, the processing requirements for daily motor vehicle emissions were prohibitive under the project schedule. Instead, a single week per month was selected to model emissions from on-road mobile sources. This week was selected from mid-month, to best represent the average temperature ranges for the month, and also adjusted to exclude holidays that would have required atypical processing. The area source modeling dates were also selected from these weeks to simplify data handling procedures. The selected weeks for area source and on-road mobile source emissions modeling were as follows:

2006 On-Road Mobile Sources Represented by the Following Weeks:

January 15-21	February 11-17
March 12-18	April 6-22
May 14-20	June 11-17
July 16-22	August 13-19
September 17-23	October 15-21
November 12-18	December 17-23

3.4 Development of Point Source Emissions

Stack parameter data are frequently incorrectly reported, especially in some of the current regional modeling inventories, and careful QA is required to assure that the point source emissions are properly located both horizontally and vertically on the modeling grid. To screen for simple, but potentially serious inventory errors such as these, the study team has modified procedures originally developed by EPA to quality assure, augment, and where necessary, revise the stack parameters to examine the accuracy of the point source emissions, as well as standardize procedures to identify and correct stack data errors. SMOKE has a number of built-in QA procedures designed to catch missing or out-of-range stack parameters. These procedures were invoked in the processing of the point source data.

Point source emissions were separated into Electric Generating Units (EGU) and non-EGU categories. The non-EGU category did not have any day or hour-specific emissions. All non-EGU point source emissions were temporally allocated to month, day, and hours using annual emissions and source category code (SCC) based allocation factors. These factors were based on the cross-reference and profile data supplied with the SMOKE 2.4 and were supplemented with relevant data that were developed during the WRAP and VISTAS modeling projects.

To temporally allocate the EGU point sources, the heat input data were derived from the 2002 Continuous Emissions Monitoring (CEM) datasets, and were used to develop facility-level temporal distributions. The day-specific and facility-specific temporal profiles were used in conjunction with the emissions data to estimate hourly EGU emissions by facility.

All point sources were spatially allocated in the domain based on the stationary source geographic coordinates. If a point source was missing its latitude/longitude coordinates, the source was placed in the center of its respective county.

3.5 Development of Area and Non-Road Source Emissions

All area and non-road source emissions were temporally allocated to month, day, and hour using annual emissions and source category code (SCC) based allocation factors. These factors were based on the cross-reference and profile data supplied with the SMOKE 2.4 and supplemented with relevant data developed during the WRAP and VISTAS studies. Area and non-road sources were spatially allocated in the domain based on SCC-based spatial surrogate allocation factors. If an area or non-road source SCC did not have an existing cross-reference profile assigned to it, the county-level emissions were allocated by population density in the respective county.

A crustal PM transport factor was applied to fugitive dust emission sources that were identified in U.S. EPA modeling to have only a portion of its mass transported from the source of the emissions generation. The EPA's studies indicated that 60 to 90 percent of PM emissions from fugitive dust sources are rapidly deposited to near-source locales; hence, do not participate in the physicochemical processes on the spatial scales that are typically used in air quality modeling simulations. For this reason, the county-specific fugitive dust emissions transport factors were applied to these sources to adjust PM emissions prior to the SMOKE modeling.

3.6 Development of On-Road Mobile Source Emissions

The MOBILE6 module of SMOKE was used to develop the base year on-road mobile source emissions estimates for CO, NOx, PM, and VOC emissions. The MOBILE6 parameters, vehicle fleet descriptions, and VMT estimates were combined with gridded, episode-specific temperature data to calculate the gridded, hourly emission estimates. Of note, whereas the on-network emissions estimates were spatially allocated based on link location and subsequently summed to the grid cell level, the off-network emissions estimates were spatially allocated based on a combination of the FHWA version 2.0 highway networks and population. For the GASCO 36/12 km modeling, no link based data were used. The MOBILE6 emissions factors were based on episode-specific temperatures predicted by the meteorological model. Further, the MOBILE6 emissions factors model accounted for the following:

- Hourly and daily minimum/maximum temperatures;
- Facility speeds;
- Locale-specific inspection and maintenance (I/M) control programs, if any;
- Adjustments for running losses;
- Splitting of evaporative and exhaust emissions into separate source categories;
- VMT, fleet turnover, and changes in fuel composition and Reid vapor pressure (RVP).

The primary input to MOBILE6 was the MOBILE shell file. The MOBILE shell contained the various options (e.g., type of inspection and maintenance program in effect, type of oxygenated fuel program in effect, alternative vehicle mix profiles, RVP of in-use fuel, operating mode) that direct the calculation of the MOBILE6 emissions factors.

3.7 Development of Biogenic Source Emissions

Biogenic emissions are generated using MEGAN, which uses high resolution GIS data on plant types and biomass loadings and the Fifth Generation National Center for Atmospheric Research/Penn State Mesoscale Model (MM5) surface temperature fields, and solar radiation (modeled or satellite-derived) to develop hourly emissions for biogenic species on the 36/12 km grids. MEGAN generates gridded, speciated, temporally allocated emission files as well as biogenic VOC precursor emission species for the new secondary organic aerosol (SOA) module in CMAQ. MEGAN was selected over BEIS as the biogenics model of choice in order to maintain consistency with the Uinta Basin Air Quality Study emissions inventory development.

3.8 Wildfires and Prescribed Burns

Wildfire and prescribed burn emissions were handled separately from the standard area source input files. The study team had nation-wide fire emissions for the 2002 year, developed for WRAP and VISTAS. Spatial and temporal distributions of the fire emissions were calculated based on this information rather than relying on standard distribution profiles. Also, the study team calculated the vertical distribution of the fire emissions, based on fire size and biomass involvement. SMOKE 2.4 can model fire plume rise if provided with the following variables:

PTOP – Top of the fire plume profile (meters above ground level)
PBOT – Bottom of the fire plume profile (meters above ground level)
Lay1 – The percent of the emissions entrained in the first modeling layer

The WRAP Fire Emissions Joint Forum Emissions Inventory Report (WRAP/FEJF, 2002) documented an approach to estimate these plume descriptors. In this method, the fires were assigned to one of 5 size categories, based on the total burn acreage, and the biomass fuel loading. These categories were then used to calculate representative hourly plume profiles. These profiles were used by SMOKE 2.4 to distribute the vertical emissions for the fires.

3.9 Products of the Emissions Inventory Development Process

In addition to the CMAQ-ready input files generated for each hour of the days modeled in the annual run, a number of quality assurance (QA) files were prepared and used to check for gross errors in the emissions inputs. Importing the model-ready emissions into the Package for Analysis and Visualization of Environmental Data (PAVE) and looking at both the spatial and temporal distribution of the emissions provided insight into the quality and accuracy of the emissions inputs. PAVE allowed for the following quality assurance checks on the emissions estimated using SMOKE 2.4:

1) Visualizing the model-ready emissions with the scale of the plots set to a very low value, areas where emissions were omitted from the raw inventory and erroneously located emissions (such as area source industrial emission in water cells) were corrected.
2) Normalizing the emissions by population for each state illustrated where the inventories may have been deficient and provided a reality check of the inventories vis-à-vis a spatial evaluation of the population weighted emissions estimates.

3) Spot checked vertical allocation of point source emissions estimates.

State inventory summaries were prepared prior to the emissions processing to compare against SMOKE output report totals generated after each major step of the emissions generation process.

To check the vertical allocation of the emissions estimates, reports were created by source, hour, and layer for randomly selected states in the domain.

Quantitative QA analyses often reveal significant deficiencies in the input data or the model setup. Sometimes it is necessary to tailor these procedures to track down the source of each problem. As such, the basic quantitative QA steps that were performed in an attempt to reveal the underlying problems with the inventories or processing are described. Some of the reports that may be generated to review the processed emissions estimates include the following:

- State and county totals from inventory for each source category
- State and county totals after spatial allocation for each source category
- State and county totals by day after temporal allocation for each source category for representative days
- State and county totals by model species after chemical speciation for each source category
- State and county model-ready totals (after spatial allocation, temporal allocation, and chemical speciation) for each source category and for all source categories combined
- If elevated source selection is chosen by user, the report indicating which sources have been selected as elevated and plume-in-grid will be included.
- Totals by source category code (SCC) from the inventory for area, mobile, and point sources
- Totals by state and SCC from the inventory for area, mobile, and point sources
- Totals by county and SCC from the inventory for area, mobile, and point sources
- Totals by SCC and spatial surrogates code for area and mobile sources
- Totals by speciation profile code for area, mobile, and point sources
- Totals by speciation profile code and SCC for area, mobile, and point sources
- Totals by monthly temporal profile code for area, mobile, and point sources
- Totals by monthly temporal profile code and SCC for area, mobile, and point sources
- Totals by weekly temporal profile code for area, mobile, and point sources
- Totals by weekly temporal profile code and SCC for area, mobile, and point sources
- Totals by diurnal temporal profile code for area, mobile, and point sources
- Totals by diurnal temporal profile code and SCC for area, mobile, and point sources

3.10 Project Emissions

Study-specific emission inventories for the simulation, described in Section 1.1, were developed for the Proposed Action without controls beyond mandates and a simulation with ACEPMs to reduce NO_X and VOC emissions beyond mandates. These inventories included the construction and operations emissions. The emissions were calculated for the predicted year of maximum development activity and emissions; 2018. Because emissions related to the Proposed Action are expected to peak in 2018, use of the WRAP 2018 inventory was possible thus allowing for the application of the best available emissions estimates for the future year.

4.0 2005/2006 Base Case Modeling Results

The CMAQ modeling database used in this study was the Uinta Basin Air Quality Study (UBAQS) developed by the Independent Petroleum Association of Mountain States (IPAMS) (IPAMS, 2009). Presented below is the technical summary of the ozone performance evaluation. The UBAQS report provides more detail on the model performance.

Table 4-1 compares the UBAQS CMAQ 2005 and 2006 base case simulation ozone model performance across CASTNet monitoring sites in the 12-km domain with EPA's hourly ozone model performance goals for bias (≤±15%) and error (≤35%) (EPA, 1991). The location of the CASTNET and AQS sites are presented in Figure 4-1. Presented in Table 4-1 are the fractional bias (FB), normalized mean bias (NMB) and mean normalized bias (MNB) ozone performance metrics (and similar metrics for error) that are calculated using hourly predicted and observed ozone pairs for which the observed value is above a 60 parts per billion (ppb) threshold (EPA, 1991) for each Quarter of 2005 and 2006. Bias and error performance statistics in Table 4-1 are only presented for Quarters when there is a minimum of at least 100 predicted and observed hourly ozone pairs available. For Q1 and Q2 in 2005 and 2006 with at least 100 predicted and observed hourly ozone pairs, the UBAQS CMAQ base case ozone performance consistently achieved EPA's ozone performance goal. During Q3 of both 2005 and 2006, the CMAQ ozone bias performance metrics were just at the -15% ozone performance goal (≤±15%) with some of the bias metrics achieving the goal, whereas others are just outside of the goal. However, the CMAQ error ozone performance metrics achieved the ≤35% ozone performance goal by a wide margin (over a factor of two all the time).

Table 4-1. Ozone model performance bias and error statistical performance measures across the five CASTNet monitoring sites in the UBAQS 12-km modeling domain and 2005 and 2006 by Quarter (statistics based on a minimum of 100 predicted/observed hourly ozone pairs, N≥100).

	Bias Metrics			**Error Metrics**			
Site	**FB**	**NMB**	**MNB**	**FE**	**NMGE**	**MNGE**	**N**
EPA Goal	*≤±15%*	*≤±15%*	*≤±15%*	*≤35%*	*≤35%*	*≤35%*	
2005 Quarter 2	-5.80	-5.16	-4.82	11.16	10.65	10.51	2015
2005 Quarter 3	-16.75	-15.04	-14.89	17.52	15.82	15.70	1388
2006 Quarter 1	-5.00	-4.52	-4.43	8.56	8.18	8.14	278
2006 Quarter 2	-4.06	-3.66	-3.40	9.14	8.87	8.77	3174
2006 Quarter 3	-16.48	-14.83	-14.71	16.86	15.21	15.11	1179

The UBAQS CMAQ base case simulations also satisfied EPA's daily maximum 8-hour ozone concentration performance goal that requires predicted daily maximum 8-hour ozone concentration "near the monitor" to be within ±20% of the observed value most of the time (EPA, 1999). Even using the most stringent definition of "near the monitor", which is based on the predicted 8-hour ozone concentration at the monitor, the CMAQ base case predicted daily maximum 8-hour ozone concentration were within ±20% of the observed value 90% and 83% of the time for the 2005 and 2006 modeling years, respectively.

The 8-hour ozone NAAQS is expressed as the three-year average of the fourth highest daily maximum 8-hour ozone concentrations. Thus, an important ozone performance issue when analyzing the future year CMAQ absolute modeling results is the fourth highest daily maximum 8-hour ozone concentration. Figure 4-2 compares the CMAQ estimated fourth highest daily maximum 8-hour ozone concentration with the observed values for 2005 and 2006. The modeled fourth highest daily maximum 8-hour ozone concentrations are comparable to the observed values. The modeled fourth highest daily maximum 8-hour ozone concentrations at the locations of the ozone monitors are usually higher than the observed value resulting in an over-prediction bias that is greater in 2006 than 2005. This ozone over-prediction bias must be accounted for when interpreting the future year absolute model ozone predictions.

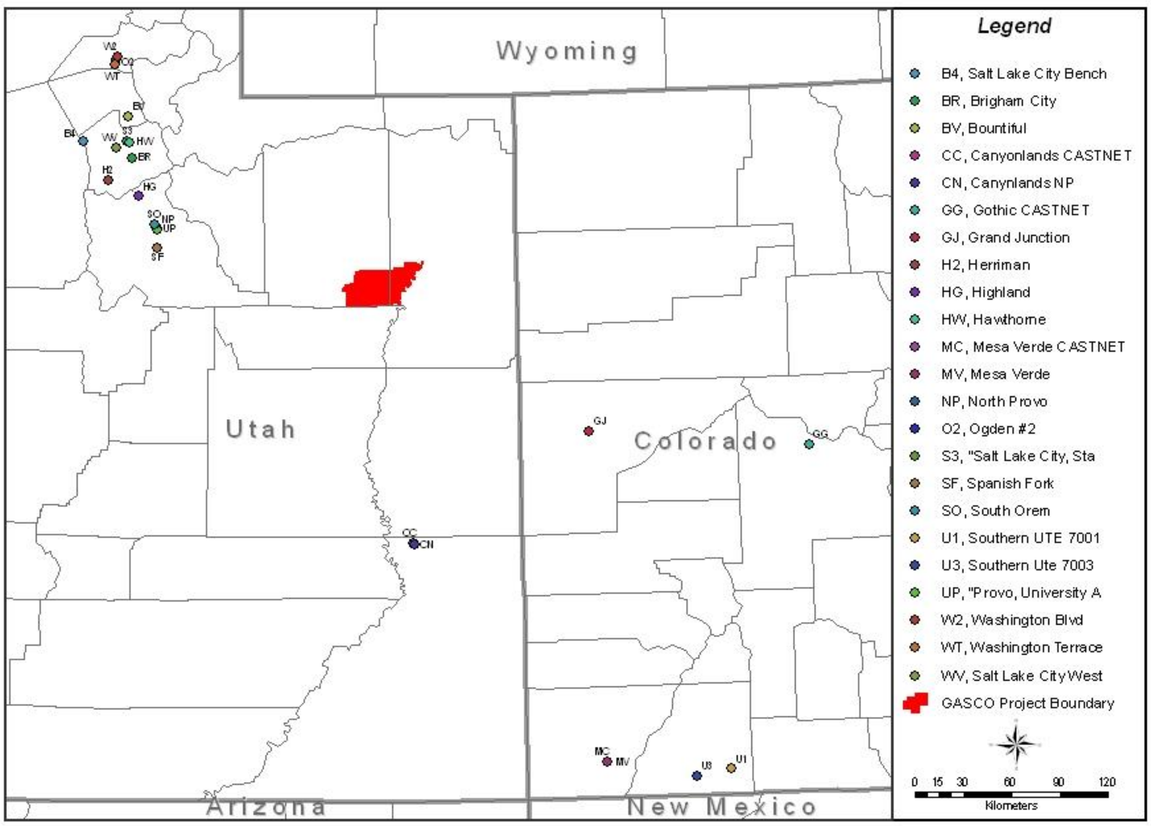
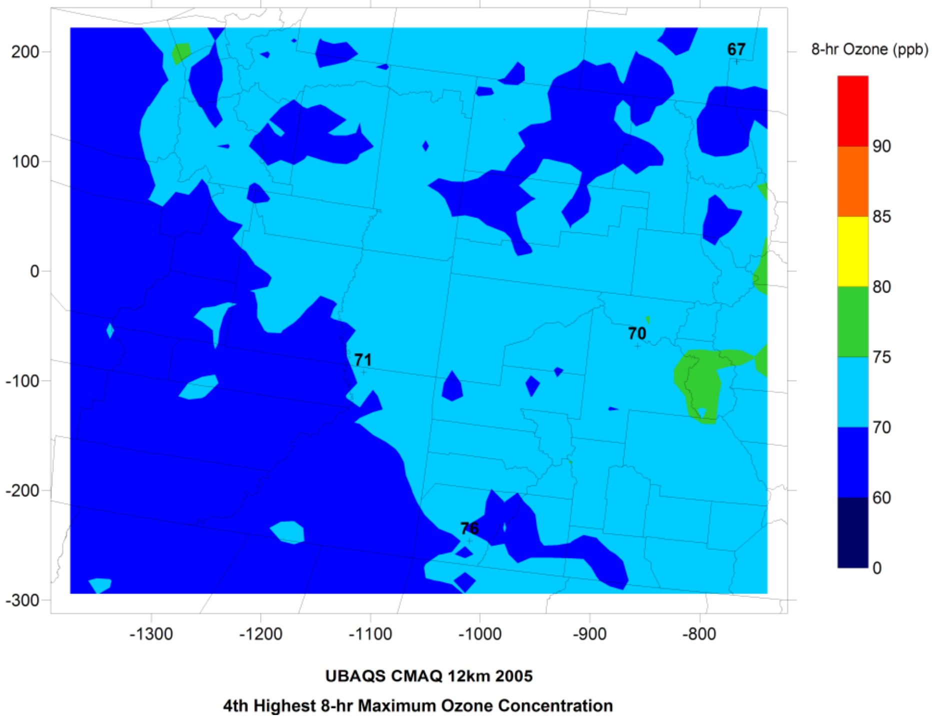


Figure 4-1: GASCO Project Area and AIRS/CASTNET Surface Stations.

2005



2006

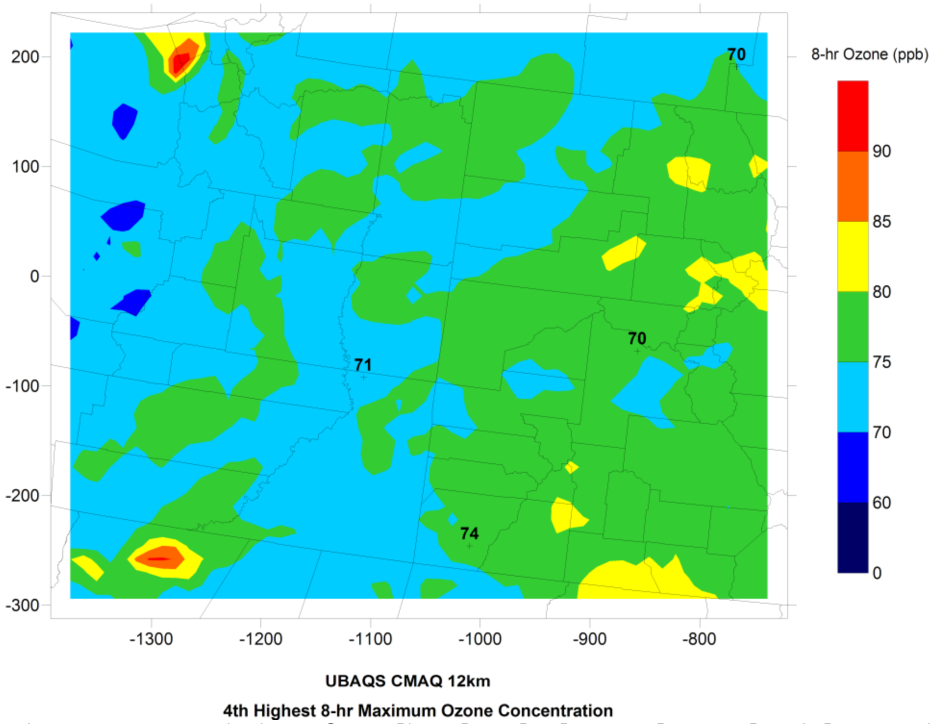


Figure 4-2: Depiction of Predicted and Observed Fourth Highest Daily Maximum 8-hour Ozone Concentrations for 2005 and 2006.

5.0 CMAQ Ozone Impact Assessment

The following subsections present the ozone impacts of the 2018 Future Year Base Case, 2018 Proposed Action, and 2018 Proposed Action with ACEPMs cases using both the USEPA guidance relative approach (USEPA 2007) and an absolute impact approach. Considerable caution must be taken in interpreting the project impacts. In traditional CMAQ ozone modeling applications, the model is applied in regions with sufficient ozone and precursor observations (monitoring) to judge the adequacy of the model for use in ozone forecasting. In this application, the closest rural monitor with a sufficiently long data record for attainment designation, Canyonlands, is approximately 150 km from the project area. Ozone observations closer to the project (Vernal and Dinosaur National Park) were operated for shorter time periods that did not correspond to the 2005/2006 period being modeling and were not able to be used for the performance evaluation. Without sufficient local monitored ozone data, the base and future year model estimated ozone levels cannot be validated; however, the comparative modeled ozone levels among the alternatives are considered a reliable evaluation.

5.1 Results Using EPA Guidance Ozone Projection Approach

EPA guidance for projecting future 8-hour ozone concentrations recommends using the photochemical grid model in a relative sense to scale current observed 8-hour ozone design values (EPA, 2007).

The EPA metrics for determining attainment of the ozone standard are based on the modeled ozone concentrations at a monitor location. For this analysis, the study area has very few available ozone measurements, so it is desirable to examine the ozone impacts both at the monitors, and also at areas removed from monitors. This section treats each in-turn.

5.1.1 EPA Guidance 8-Hour Ozone Projection Procedures

USEPA guidance for projecting future 8-hour ozone concentrations recommends using the photochemical grid model in a relative sense to scale current observed 8-hour design values (USEPA 2007). A design value is defined as a 3-year average of the fourth highest daily maximum 8-hour ozone concentrations at a monitor. Model scaling factors, referred to as relative response factors (RRFs), are used to scale the observed design values in order to predict future year design values. RRFs are the ratio of the future year (or the control case) to the current-year modeled 8-hour ozone concentrations near a monitor site. USEPA has defined "near the monitor" to be approximately 15 km from the monitor location. The future-year design value (DVf) is obtained from the current-year design value (DVc) using the relation:

$$DVf = DVc \, x \, RRF$$

The RRFs are calculated for all days in which the current-year modeled 8-hour ozone value is above a threshold. This is done so that the model response to future changes in emissions is considered only on high ozone days of comparable conditions to the days used to produce the DVc. USEPA recommends a threshold between 70 and 85 ppb.

To perform the 8-hour projections, USEPA has developed the Modeled Attainment Test Software (MATS) tool that uses modeling results, 8-hour ozone design values and follows USEPA guidance (USEPA 2007) to project 8-hour ozone concentrations that reflect the change in emissions from the base case to an alternative emissions scenario.

EPA recommends using a DVc based on an average of three year 8-hour ozone Design Values that span 5 consecutive years centered on the modeling year (i.e., a weighted average of 5 years of fourth highest daily maximum 8-hour ozone concentrations). For example, for the 2006 baseline modeling year used in this analysis, this would mean the DVc at a given monitor would be the weighted average of the fourth highest 8-hour daily maximum ozone at that monitor from the years 2004, 2005, 2006, 2007 and 2008 using weights of 1, 2, 3, 2 and 1, respectively. To develop RRFs, EPA guidance recommends using current and future modeling results for all days in which the current year daily maximum 8-hour ozone concentration near the monitor exceeds an ozone threshold value. For a 12-km grid, as in the GASCO CMAQ modeling, the maximum modeled daily maximum 8-hour ozone concentration in a 3 x 3 array of grid cells centered on the monitor is used. EPA recommends using an 8-hour ozone threshold concentration of 85 ppb and also recommends that RRFs be based on a minimum of 5 days, although a total of 10 days or more is preferred. EPA allows a reduction of the threshold value to 70 ppb to meet the minimum 5-10 days requirement. These procedures were developed mainly for urban ozone nonattainment areas where there are typically many more days of elevated ozone concentrations than are observed in the rural Uinta Basin study area.

There are several issues with using the MATS tool in its standard configuration for the GASCO ozone analysis. The most serious is that the monitoring network is relatively dense in the Salt Lake but sparse throughout the rest of Utah, with no monitors in the Uinta Basin that have a sufficiently long data record to allow inclusion in the MATS tool (Figure 5-1). Therefore, use of the MATS tool as is would result in the DVCs in Uintah County, Utah being based on interpolation of DVCs from monitors hundreds of kilometers away in the Salt Lake City area, San Juan County, Utah (Cayonlands) and the Gothic, Colorado and Centennial, Wyoming CASTNet sites. This results in the interpolation of high Salt Lake City ozone values typical of an urban area across the Wasatch Range into the rural Uinta Basin region. Note that the Uinta Basin is not part of the Salt Lake City airshed. In addition, restricting sites used in MATS to those with a minimum of 5 days of DVc greater than 70 ppb means that MATS cannot project future ozone in the middle of the Uinta Basin and leaves this area blank in plotting future year design values in the Unmonitored Area Analysis. The most effective way to remedy this problem is to include monitors that record ozone data according to EPA standard methods, but are not included in the default MATS tool because they have fewer than five years of data available.

For this analysis a MATS assessment was performed in which all available data were used. While this may not be acceptable to NAAQS attainment designation, this approach leads to a more informative analysis. The 5 year data requirement to construct DVc was relaxed so that sites with a minimum of 1 year of data were included as DVc in the analysis. DVc for sites with multiple years of record were based on the three year 8-hour ozone Design Value that spanned 2004-2008. In the enhanced MATS Unmonitored Area Analysis grid cells are included in the RRF calculation if they had 1 or more days over both a 70 ppb and a 60 ppb threshold.

The most important difference in the Uinta Basin is the addition of DVc associated with the Vernal, Utah ozone monitor and the monitor at Dinosaur National Monument. The Vernal monitor lies within the Uinta Basin and was active in 2007 and the fourth highest daily maximum 8-hour ozone concentration was used for the DVc. The DVc for the Dinosaur National Monument was based on three years of monitoring data (2006-2008) with the three-year average fourth highest daily maximum 8-hour ozone concentrations used as the DVc.

The 8-hour ozone projections are performed three times for each meteorological year. The first projection is performed using the 2006 typical simulation and the Future Year Base Case. Projections are then run comparing the Alternative cases to the 2006 typical simulation. The project impacts are the differences in the future design values between the Alternative simulations and the Future Year Base Case simulation. Additionally, comparison of the Proposed Action and the Proposed Action with ACEPMs simulations can be used to examine the potential ozone concentration improvement of the additional controls.

5.1.2 Impact Assessment at Monitors

Monitor station 2006 design values (DVc), 2018 future year design values (DVf) and the RRF for the 2018 Future Year Base Case, 2018 Proposed Action and 2018 Proposed Action with ACEPMs for all stations in the domain analyzed over the entire 2018 period run with 2005 and 2006 meteorology with a minimum ozone threshold of 70 ppb are presented in Tables 5-1 and 5-2, respectively. EPA Guidance (EPA, 2007) suggests truncating ozone concentrations to the parts per billion level when performing attainment testing. However, for this analysis the results are presented to the tenth of a ppb to better resolve potential project impacts.

For the 2005 meteorological year (Table 5-1) the Proposed Action scenario increases ozone design values by 0.1 ppb at 5 monitors. The Proposed Action with ACEPMs scenario increases ozone by 0.1 ppb at 2 monitors. The CMAQ model indicated greater impacts from the project using the 2006 meteorology. For the 2006 meteorological year (Table 5-2) the Proposed Action scenario increases ozone by 0.1 ppb at 5 monitors, by 0.2 ppb at the Dinosaur NM monitor. The Proposed Action with ACEPMs scenario increases ozone by 0.1 ppb at 5 monitors. Tables 5-1 and Table 5-2 show that for all three future scenarios all monitors in the modeling domain are predicted to be in attainment of the 75 ppb ozone NAAQS.

Analogous tables with the MATS analysis run with a minimum threshold of 60 ppb are presented in Tables 5-3 and 5-4 for the 2005 and 2006 meteorologies, respectively. The impact results are very similar to the impacts with the 70 ppb threshold. For the 2005 meteorology (Table 5-3) the maximum impact is 0.1 ppb, which occurs at 5 stations for the Proposed Action case. For the Proposed Action with ACEPMs case again, the maximum impact is 0.1 ppb, but this only occurs at two stations. For the 2006 meteorology (Table 5-4) the Proposed Action case shows an impact of 0.1 ppb at 6 monitors, and a 0.2 ppb impact at the Dinosaur NM monitor. The Proposed Action with ACEPMs case shows a maximum impact of 0.1 ppb at 7 monitors.

5.1.3 Impact Assessment Removed from Monitors

To assess the project impacts in areas removed from monitor locations, EPA guidance calls for an unmonitored area analysis. For this application, the MATS tool is used to prepare spatial fields of the projected future year ozone design values throughout the 12-km domain. EPA does not determine attainment of the 8-hour standard based on the unmonitored area analysis. Rather the unmonitored analysis is used as more of a weight of evidence analysis (EPA, 2007).

Figure 5-1 presents the 2006 MATS estimated ozone design values using the 2005 and 2006 meteorologies. For both meteorological years the highest values are estimated to occur in the Salt Lake City area. For the 2005 meteorology in the GASCO project area the estimated design values are sub 70 ppb. For the 2006 meteorology the majority of the values are sub 70 ppb with one grid cell in the range of 70 to 73 ppb. No grid cells in the vicinity of the GASCO project area are estimated to have design values in excess of the 75 ppb ozone NAAQS.

Figures 5-2 through 5-7 present the results of the MATS analysis with a minimum threshold of 70 ppb. Figure 5-2 presents the 2018 projected project Future Year Base Case design values. For both years of meteorology the CMAQ model is generally estimating a decrease in the design value across the domain. Figure 5-3 presents the 2018 design values which include the GASCO Proposed Action emissions. The results are near indistinguishable from the 2018 project Future Year Base Case figures. Analogous Proposed Action with ACEPMs scenario results are presented in Figure 5-4. Again the differences are difficult to distinguish from either the project Future Year Base Case or the Proposed Action cases. The model is not estimating ozone concentrations in excess of the 75 ppb standard in the project area for any simulations.

To focus on the differences in the 2018 design values, difference plots between the various simulations were prepared. Figure 5-5 presents the differences in the design values between the project Future Year Base Case and the project Proposed Action simulations. The project emissions show more impact in the 2006 meteorology than the 2005. The maximum increase with the 2005 meteorology is 0.3 ppb occurring southwest of the project and only a limited area showing impacts of ±0.2 ppb. With the 2006 meteorology the maximum increase is 0.5 ppb in the project area with the project emissions showing a 0.2 ppb or greater impact over portions of Uintah County and into Colorado.

Figure 5-6 presents the design value differences between the Proposed Action with ACEPMs simulation and the 2018 project Future Year Base Case. As with the Proposed Action case, the 2006 meteorology shows more project impact. The maximum project impact with the 2005 meteorology is 0.2 ppb occurring southwest of the project area with less than 0.2 ppb impact in the project area. The 2006 meteorology simulation shows a maximum project impact of 0.4 ppb in the vicinity of the project area and small areas to the east of the project area.

Differences between the Proposed Action and Proposed Action with ACEPMs cases are presented in Figure 5-7 for the 2005 and 2006 meteorology, respectively. With the 2005 meteorology the maximum ACEPM difference is 0.2 ppb with a single grid cell showing a change of 0.2 ppb or greater. For the 2006 meteorology the maximum ACEPM difference is 0.2 ppb with three grid cells showing a change of 0.2 ppb or greater.

Figures 5-8 through 5-13 present the results of the MATS analysis with a minimum threshold of 60 ppb. Figure 5-8 presents the 2018 projected project Future Year Base Case design values. For both years of meteorology the CMAQ model is generally estimating a decrease in the design value across the domain. Figure 5-9 presents the 2018 design values which include the GASCO Proposed Action emissions. The results are near indistinguishable from the 2018 project Future Year Base Case figures. Analogous Proposed Action with ACEPMs scenario results are presented in Figure 5-10. Again the differences are difficult to distinguish from either the project Future Year Base Case or the Proposed Action cases. The model is not estimating ozone concentrations in excess of the 75 ppb standard in the project area for any simulations.

To focus on the differences in the 2018 design values, difference plots between the various simulations were prepared. Figure 5-11 presents the differences in the design values between the project Future Year Base Case and the project Proposed Action simulations with the 60 ppb threshold. The project emissions show more impact in the 2006 meteorology than the 2005. The maximum increase with the 2005 meteorology is 0.3 ppb occurring southwest of the project area and only a limited area showing impacts of ± 0.2 ppb. With the 2006 meteorology the maximum increase is 0.6 ppb in the project area with the project emissions showing a 0.2 ppb or greater impact over portions of Uintah County and into Colorado.

Figure 5-12 present the design value differences between the Proposed Action with ACEPMs simulation and the 2018 project Future Year Base Case with a 60 ppb threshold. As with the Proposed Action case, the 2006 meteorology shows more project impact. The maximum project impact with the 2005 meteorology is 0.2 ppb occurring in the project area. The 2006 meteorology simulation shows a maximum project impact of 0.4 ppb in the vicinity of the project area and small areas to the east of the project area showing an impact of 0.2 ppb or greater.

Differences between the Proposed Action and Proposed Action with ACEPMs cases are presented in Figure 5-13 for the 2005 and 2006 meteorology, respectively with a 60 ppb threshold. With the 2005 meteorology the ACEPM difference is 0.1 ppb with no grid cells showing a change of 0.2 ppb or greater. For the 2006 meteorology the maximum ACEPM difference is 0.2 ppb with three grid cells showing a change of 0.2 ppb or greater.

5.2 Ozone Projections Using Absolute Modeling Results

As was stated previously, the USEPA preferred approach for use of photochemical models to assess ozone attainment is to use air quality model results in a relative sense. However, another approach is to use the model in an absolute sense. Again, the lack of observations in the vicinity of the GASCO study area make it impossible to assess whether the CMAQ model is able to replicate the ozone levels in the base year and hence reduces the credibility of the model to estimate future ozone concentrations.

The fourth highest ozone concentrations for 2018 project Future Year Base Case with the 2005 and 2006 meteorology are presented in Figure 5-14. With the 2005 meteorology the GASCO project area is estimated to have sub 70 ppb ozone concentrations. With the 2006 meteorology the study area is estimated to have sub 76 ppb ozone concentrations. The model is not simulating a fourth high ozone concentration of 76 ppb or greater in the vicinity of the project area with either year of meteorology.

Fourth high ozone concentrations for the Proposed Action case are presented in Figure 5-15. The spatial patterns are very similar to the project baseline, with only a few grid cells near the GASCO project area showing difference. Proposed Action with ACEPMs case fourth high ozone concentrations are presented in Figure 5-16. Again, the spatial patterns are nearly identical. With both cases no grid cells in the study area exceed 76 ppb.

As was performed for the unmonitored area analysis, differences between the different alternatives were prepared to highlight the differences. Figure 5-17 presents differences between the Proposed Action and the project Future Year Base Case using the 2005 and 2006 meteorologies. For the 2005 meteorology the maximum ozone increase is 0.7 ppb with the impact area being generally oriented southwest to northeast. For the 2006 meteorology the maximum increase is 1.9 ppb. Analogous plots for the Proposed Action with ACEPMs case are presented in Figure 5-18. For the 2005 meteorology the maximum increase is 0.5 ppb and for the 2006 meteorology the maximum increase is 1.3 ppb. Finally, differences between the Proposed Action with ACEPMs and the Proposed Action cases are presented in Figure 5-19. The maximum difference due to the ACEPMs with 2005 meteorology is 0.2 ppb and the maximum difference with 2006 meteorology is 0.6 ppb.

5.3 Ozone Impact Assessment Summary

The project impacts for the 2018 Future Year Base Case, Proposed Action, and Proposed Action with ACEPMs scenarios were examined using both the USEPA recommended relative approach and an absolute approach. Using the relative approach at the monitors, the criteria used by USEPA to show attainment of the NAAQS, indicates that all monitors are simulated to be below the 75 ppb NAAQS for all scenarios. The maximum predicted impact at a monitor for the Proposed Action case is 0.2 ppb. The maximum predicted impact at a monitor for the Proposed Action with ACEPMs case is 0.1 ppb. For both cases the maximum predicted impact was at the Dinosaur National Monument monitor. That monitor does not have a sufficiently long data record for it to be used in a formal attainment designation. The maximum predicted impact at an AIRS monitor that could be used for attainment designation was 0.1 ppb for both the Proposed Action and the Proposed Action with ACEPMs.

Using the USEPA recommended relative non-monitored area analysis, no areas in the vicinity of the GASCO project area are simulated to exceed the 75 ppb ozone standard with either the 2005 or 2006 meteorologies for any of the project alternatives. The maximum predicted impact from the Proposed Action case is 0.6 ppb. The maximum predicted impact from the Proposed Action with ACEPMs case is 0.4 ppb. For both cases, the areas of predicted maximum impact are occurring in areas simulated to be below the 75 ppb ozone standard.

Using the more uncertain absolute impact approach, none of the project alternative cases predict any regions in the GASCO project area to be in excess of the 75 ppb standard. On an absolute basis the project emissions are predicted to increase ozone by a maximum of 1.9 ppb for the Proposed Action case and 1.3 ppb for the Proposed Action with ACEPMs case.

Table 5-1. Annual monitor station 2005 meteorological year 8-hour ozone design values (DVc) and future year design values (DVf) for 2018 Future Year Base Case, and 2018 Proposed Action for monitors in the 12-km modeling domain with a 70 ppb minimum threshold.									
			Baseline	Future Year Base Case		Proposed Action		Proposed Action with ACEPMs	
Monitor ID	State	Name	DVc	DVf	RRF	DVf	RRF	DVf	RRF
80450012	CO	Rifle - Heath	66.0	60.4	0.9152	60.4	0.9158	60.4	0.9156
80677001	CO	LaPlata7001	56.3	50.0	0.8892	50.0	0.8893	50.0	0.8892
80677003	CO	LaPlata7003	65.3	56.8	0.8700	56.8	0.8700	56.8	0.8700
80679000	CO	Shamrock	71.3	66.4	0.9317	66.4	0.9317	66.4	0.9317
80770020	CO	Palisade-Water	70.0	64.2	0.9184	64.3	0.9190	64.3	0.9188
80771001	CO	Colorado NM	69.0	62.7	0.9092	62.7	0.9096	62.7	0.9095
80830101	CO	Montezuma0101	72.3	64.1	0.8869	64.1	0.8870	64.1	0.8869
350450009	NM	SanJuan0009	67.3	61.8	0.9185	61.8	0.9185	61.8	0.9185
350450018	NM	Navajo Dam	77.0	70.4	0.9149	70.4	0.9150	70.4	0.9150
350451005	NM	SanJuan1005	71.0	66.0	0.9300	66.0	0.9300	66.0	0.9300
490110004	UT	Davis0004	80.0	69.1	0.8641	69.1	0.8641	69.1	0.8641
490350003	UT	SaltLake0003	80.0	72.5	0.9074	72.5	0.9074	72.5	0.9074
490352004	UT	SaltLake2004	80.0	63.0	0.7877	63.0	0.7877	63.0	0.7877
490353006	UT	SaltLake30006	77.0	69.1	0.8986	69.1	0.8986	69.1	0.8986
490353007	UT	SaltLake3007	78.0	64.4	0.8258	64.4	0.8258	64.4	0.8258
490353008	UT	SaltLake3008	78.0	66.5	0.8529	66.5	0.8529	66.5	0.8529
490370101	UT	SanJuan0101	71.0	62.2	0.8763	62.2	0.8764	62.2	0.8764
490471002	UT	Dinosaur NM	65.0	59.1	0.9101	59.2	0.9111	59.1	0.9107
490490002	UT	Utah0002	73.0	64.7	0.8866	64.7	0.8867	64.7	0.8867
490495008	UT	Utah5008	75.0	67.4	0.8990	67.4	0.8990	67.4	0.8990
490495010	UT	Utah5010	76.0	65.9	0.8676	65.9	0.8677	65.9	0.8677
490570007	UT	Weber0007	78.0	66.7	0.8553	66.7	0.8553	66.7	0.8553
490571003	UT	Weber1003	79.0	67.5	0.8553	67.5	0.8553	67.5	0.8553
Black_CnNP	CO	Black_CnNP	74.0	67.2	0.9089	67.2	0.9090	67.2	0.9090
Cent_WY	WY	Cent_WY	68.0	63.0	0.9265	63.0	0.9266	63.0	0.9265
EnCanaCyn	CO	EnCanaCyn	68.0	62.5	0.9193	62.5	0.9200	62.5	0.9197
EnCanaMtn	CO	EnCanaMtn	68.0	63.2	0.9307	63.3	0.9309	63.2	0.9308
Gothic	CO	Gothic	67.7	63.8	0.9438	63.9	0.9442	63.9	0.9440
USFS-Sunlight	CO	USFS-Sunlight	70.0	64.0	0.9156	64.1	0.9160	64.1	0.9158
USFS_Ajax	CO	USFS_Ajax	77.0	71.8	0.9328	71.8	0.9332	71.8	0.9331
USFS_Bell	CO	Garfield	70.5	63.0	0.8945	63.1	0.8951	63.0	0.8949
USFS_Ripp	CO	USFS_Ripp	66.0	61.0	0.9256	61.0	0.9257	61.0	0.9257
Vernal	UT	Vernal	68.9	64.0	0.9293	64.0	0.9297	64.0	0.9296

Table 5-2. Annual monitor station 2006 meteorological year 8-hour ozone design values (DVc) and future year design values (DVf) for 2018 Future Year Base Case, and 2018 Proposed Action for monitors in the 12-km modeling domain with a 70 ppb minimum threshold.

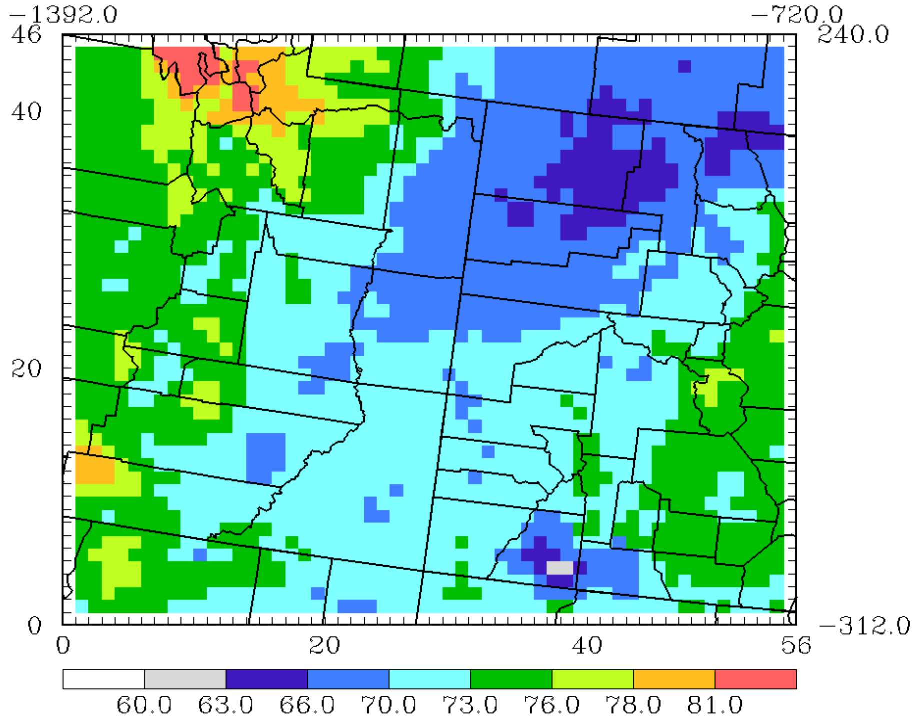
			Baseline	Future Year Base Case		Proposed Action		Proposed Action with ACEPMs	
Monitor ID	State	Name	DVc	DVf	RRF	DVf	RRF	DVf	RRF
80450012	CO	Rifle - Heath	66.0	59.8	0.9062	59.8	0.9068	59.8	0.9066
80677001	CO	LaPlata7001	56.3	51.8	0.9210	51.8	0.9211	51.8	0.9211
80677003	CO	LaPlata7003	65.3	59.9	0.9176	59.9	0.9176	59.9	0.9176
80679000	CO	Shamrock	71.3	66.1	0.9282	66.1	0.9282	66.1	0.9282
80770020	CO	Palisade-Water	70.0	63.8	0.9124	63.8	0.9126	63.8	0.9126
80771001	CO	Colorado NM	69.0	62.6	0.9077	62.6	0.9080	62.6	0.9079
80830101	CO	Montezuma0101	72.3	65.5	0.9069	65.5	0.9070	65.5	0.9069
350450009	NM	SanJuan0009	67.3	62.7	0.9331	62.8	0.9332	62.8	0.9332
350450018	NM	Navajo Dam	77.0	71.0	0.9221	71.0	0.9221	71.0	0.9221
350451005	NM	SanJuan1005	71.0	66.3	0.9340	66.3	0.9341	66.3	0.9340
490110004	UT	Davis0004	80.0	73.2	0.9160	73.2	0.9162	73.2	0.9161
490350003	UT	SaltLake0003	80.0	71.2	0.8907	71.2	0.8909	71.2	0.8908
490352004	UT	SaltLake2004	80.0	67.6	0.8459	67.6	0.8461	67.6	0.8460
490353006	UT	SaltLake30006	77.0	68.0	0.8841	68.0	0.8843	68.0	0.8842
490353007	UT	SaltLake3007	78.0	66.5	0.8534	66.5	0.8537	66.5	0.8536
490353008	UT	SaltLake3008	78.0	71.6	0.9186	71.6	0.9188	71.6	0.9187
490370101	UT	SanJuan0101	71.0	64.0	0.9027	64.1	0.9033	64.1	0.9031
490471002	UT	Dinosaur NM	65.0	59.4	0.9145	59.6	0.9172	59.5	0.9163
490490002	UT	Utah0002	73.0	65.1	0.8930	65.1	0.8930	65.1	0.8930
490495008	UT	Utah5008	75.0	66.2	0.8836	66.2	0.8837	66.2	0.8837
490495010	UT	Utah5010	76.0	67.1	0.8838	67.1	0.8838	67.1	0.8838
490570007	UT	Weber0007	78.0	70.7	0.9066	70.7	0.9068	70.7	0.9067
490571003	UT	Weber1003	79.0	71.6	0.9066	71.6	0.9068	71.6	0.9067
Black_CnNP	CO	Black_CnNP	74.0	68.3	0.9239	68.3	0.9240	68.3	0.9240
Cent_WY	WY	Cent_WY	68.0	64.3	0.9460	64.3	0.9465	64.3	0.9463
EnCanaCyn	CO	EnCanaCyn	68.0	62.0	0.9132	62.1	0.9136	62.1	0.9135
EnCanaMtn	CO	EnCanaMtn	68.0	61.8	0.9090	61.8	0.9094	61.8	0.9092
Gothic	CO	Gothic	67.7	63.1	0.9329	63.1	0.9331	63.1	0.9330
USFS-Sunlight	CO	USFS-Sunlight	70.0	64.7	0.9245	64.7	0.9247	64.7	0.9246
USFS_Ajax	CO	USFS_Ajax	77.0	71.8	0.9330	71.8	0.9331	71.8	0.9330
USFS_Bell	CO	Garfield	70.5	64.1	0.9106	64.2	0.9109	64.2	0.9108
USFS_Ripp	CO	USFS_Ripp	66.0	62.8	0.9517	62.8	0.9522	62.8	0.9520
Vernal	UT	Vernal	68.9	63.6	0.9236	63.7	0.9250	63.6	0.9245

Table 5-3. Annual monitor station 2005 meteorological year 8-hour ozone design values (DVc) and future year design values (DVf) for 2018 Future Year Base Case, and 2018 Proposed Action for monitors in the 12-km modeling domain with a 60 ppb minimum threshold.

			Baseline	Future Year Base Case		Proposed Action		Proposed Action with ACEPMs	
Monitor ID	State	Name	DVc	DVf	RRF	DVf	RRF	DVf	RRF
80450012	CO	Rifle - Heath	66.0	60.4	0.9152	60.4	0.9158	60.4	0.9156
80677001	CO	LaPlata7001	56.3	50.0	0.8892	50.0	0.8893	50.0	0.8892
80677003	CO	LaPlata7003	65.3	56.8	0.8700	56.8	0.8700	56.8	0.8700
80679000	CO	Shamrock	71.3	66.4	0.9317	66.4	0.9317	66.4	0.9317
80770020	CO	Palisade-Water	70.0	64.7	0.9252	64.7	0.9256	64.7	0.9255
80771001	CO	Colorado NM	69.0	62.4	0.9047	62.4	0.9051	62.4	0.9050
80830101	CO	Montezuma0101	72.3	64.1	0.8869	64.1	0.8870	64.1	0.8869
350450009	NM	SanJuan0009	67.3	61.8	0.9185	61.8	0.9185	61.8	0.9185
350450018	NM	Navajo Dam	77.0	70.4	0.9149	70.4	0.9150	70.4	0.9150
350451005	NM	SanJuan1005	71.0	66.0	0.9300	66.0	0.9300	66.0	0.9300
490110004	UT	Davis0004	80.0	69.1	0.8641	69.1	0.8641	69.1	0.8641
490350003	UT	SaltLake0003	80.0	72.5	0.9065	72.5	0.9066	72.5	0.9066
490352004	UT	SaltLake2004	80.0	63.0	0.7877	63.0	0.7877	63.0	0.7877
490353006	UT	SaltLake30006	77.0	69.1	0.8986	69.1	0.8986	69.1	0.8986
490353007	UT	SaltLake3007	78.0	64.4	0.8258	64.4	0.8258	64.4	0.8258
490353008	UT	SaltLake3008	78.0	69.1	0.8862	69.1	0.8862	69.1	0.8862
490370101	UT	SanJuan0101	71.0	64.7	0.9120	64.7	0.9122	64.7	0.9121
490471002	UT	Dinosaur NM	65.0	59.7	0.9193	59.8	0.9202	59.7	0.9199
490490002	UT	Utah0002	73.0	64.7	0.8873	64.7	0.8874	64.7	0.8873
490495008	UT	Utah5008	75.0	67.4	0.8990	67.4	0.8990	67.4	0.8990
490495010	UT	Utah5010	76.0	66.9	0.8811	66.9	0.8811	66.9	0.8811
490570007	UT	Weber0007	78.0	66.7	0.8553	66.7	0.8553	66.7	0.8553
490571003	UT	Weber1003	79.0	67.5	0.8553	67.5	0.8553	67.5	0.8553
Black_CnNP	CO	Black_CnNP	74.0	68.4	0.9253	68.4	0.9253	68.4	0.9253
Cent_WY	WY	Cent_WY	68.0	64.2	0.9443	64.2	0.9444	64.2	0.9443
EnCanaCyn	CO	EnCanaCyn	68.0	62.8	0.9241	62.8	0.9246	62.8	0.9244
EnCanaMtn	CO	EnCanaMtn	68.0	63.2	0.9307	63.3	0.9309	63.2	0.9308
Gothic	CO	Gothic	67.7	63.8	0.9438	63.9	0.9442	63.9	0.9440
USFS-Sunlight	CO	USFS-Sunlight	70.0	64.0	0.9156	64.1	0.9160	64.1	0.9158
USFS_Ajax	CO	USFS_Ajax	77.0	71.8	0.9328	71.8	0.9332	71.8	0.9331
USFS_Bell	CO	Garfield	70.5	65.0	0.9224	65.0	0.9227	65.0	0.9226
USFS_Ripp	CO	USFS_Ripp	66.0	61.0	0.9256	61.0	0.9257	61.0	0.9257
Vernal	UT	Vernal	68.9	63.4	0.9206	63.4	0.9209	63.4	0.9207

Table 5-4. Annual monitor station 2006 meteorological year 8-hour ozone design values (DVc) and future year design values (DVf) for 2018 Future Year Base Case, and 2018 Proposed Action for monitors in the 12-km modeling domain with a 60 ppb minimum threshold.									
			Baseline	Future Year Base Case		Proposed Action		Proposed Action with ACEPMs	
Monitor ID	State	Name	DVc	DVf	RRF	DVf	RRF	DVf	RRF
80450012	CO	Rifle - Heath	66.0	59.8	0.9062	59.8	0.9068	59.8	0.9066
80677001	CO	LaPlata7001	56.3	51.8	0.9210	51.8	0.9211	51.8	0.9211
80677003	CO	LaPlata7003	65.3	59.9	0.9176	59.9	0.9176	59.9	0.9176
80679000	CO	Shamrock	71.3	66.1	0.9282	66.1	0.9282	66.1	0.9282
80770020	CO	Palisade-Water	70.0	63.8	0.9124	63.8	0.9126	63.8	0.9126
80771001	CO	Colorado NM	69.0	62.6	0.9077	62.6	0.9080	62.6	0.9079
80830101	CO	Montezuma0101	72.3	65.5	0.9069	65.5	0.9070	65.5	0.9069
350450009	NM	SanJuan0009	67.3	62.7	0.9331	62.8	0.9332	62.8	0.9332
350450018	NM	Navajo Dam	77.0	71.0	0.9221	71.0	0.9221	71.0	0.9221
350451005	NM	SanJuan1005	71.0	66.3	0.9340	66.3	0.9341	66.3	0.9340
490110004	UT	Davis0004	80.0	73.2	0.9160	73.2	0.9162	73.2	0.9161
490350003	UT	SaltLake0003	80.0	71.2	0.8907	71.2	0.8909	71.2	0.8908
490352004	UT	SaltLake2004	80.0	67.6	0.8459	67.6	0.8461	67.6	0.8460
490353006	UT	SaltLake30006	77.0	68.0	0.8841	68.0	0.8843	68.0	0.8842
490353007	UT	SaltLake3007	78.0	66.5	0.8534	66.5	0.8537	66.5	0.8536
490353008	UT	SaltLake3008	78.0	71.6	0.9186	71.6	0.9188	71.6	0.9187
490370101	UT	SanJuan0101	71.0	64.0	0.9027	64.1	0.9033	64.1	0.9031
490471002	UT	Dinosaur NM	65.0	59.5	0.9164	59.7	0.9186	59.6	0.9178
490490002	UT	Utah0002	73.0	65.1	0.8930	65.1	0.8930	65.1	0.8930
490495008	UT	Utah5008	75.0	66.2	0.8836	66.2	0.8837	66.2	0.8837
490495010	UT	Utah5010	76.0	67.1	0.8838	67.1	0.8838	67.1	0.8838
490570007	UT	Weber0007	78.0	70.7	0.9066	70.7	0.9068	70.7	0.9067
490571003	UT	Weber1003	79.0	71.6	0.9066	71.6	0.9068	71.6	0.9067
Black_CnNP	CO	Black_CnNP	74.0	68.3	0.9239	68.3	0.9240	68.3	0.9240
Cent_WY	WY	Cent_WY	68.0	62.0	0.9132	62.1	0.9135	62.1	0.9134
EnCanaCyn	CO	EnCanaCyn	68.0	62.0	0.9132	62.1	0.9136	62.1	0.9135
EnCanaMtn	CO	EnCanaMtn	68.0	61.8	0.9090	61.8	0.9094	61.8	0.9092
Gothic	CO	Gothic	67.7	63.1	0.9329	63.1	0.9331	63.1	0.9330
USFS-Sunlight	CO	USFS-Sunlight	70.0	64.7	0.9245	64.7	0.9247	64.7	0.9246
USFS_Ajax	CO	USFS_Ajax	77.0	71.8	0.9330	71.8	0.9331	71.8	0.9330
USFS_Bell	CO	Garfield	70.5	64.1	0.9106	64.2	0.9109	64.2	0.9108
USFS_Ripp	CO	USFS_Ripp	66.0	62.8	0.9517	62.8	0.9522	62.8	0.9520
Vernal	UT	Vernal	68.9	63.3	0.9199	63.4	0.9210	63.4	0.9206

2005



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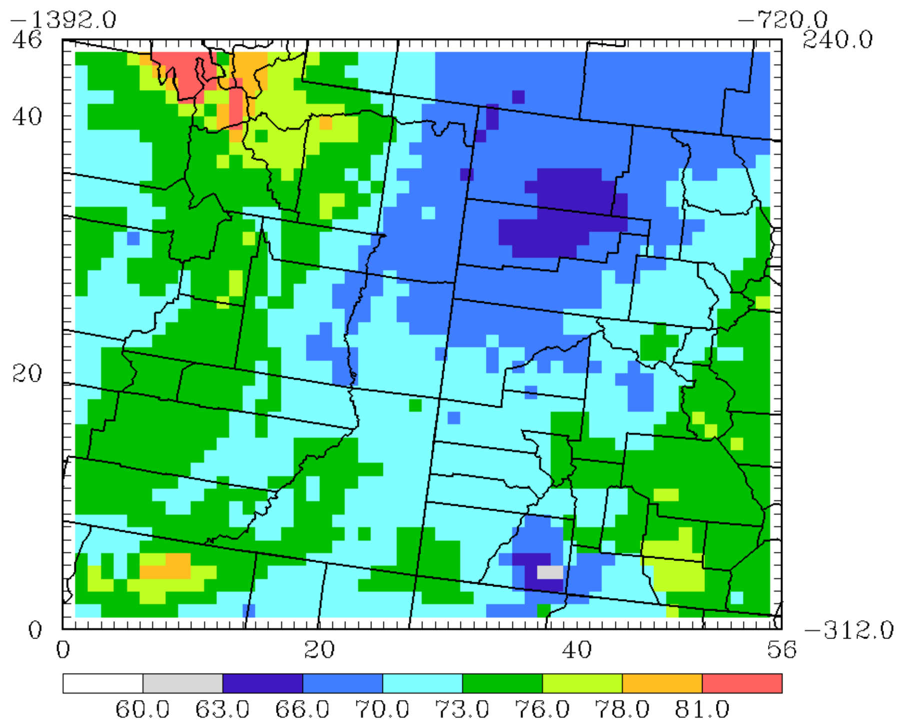
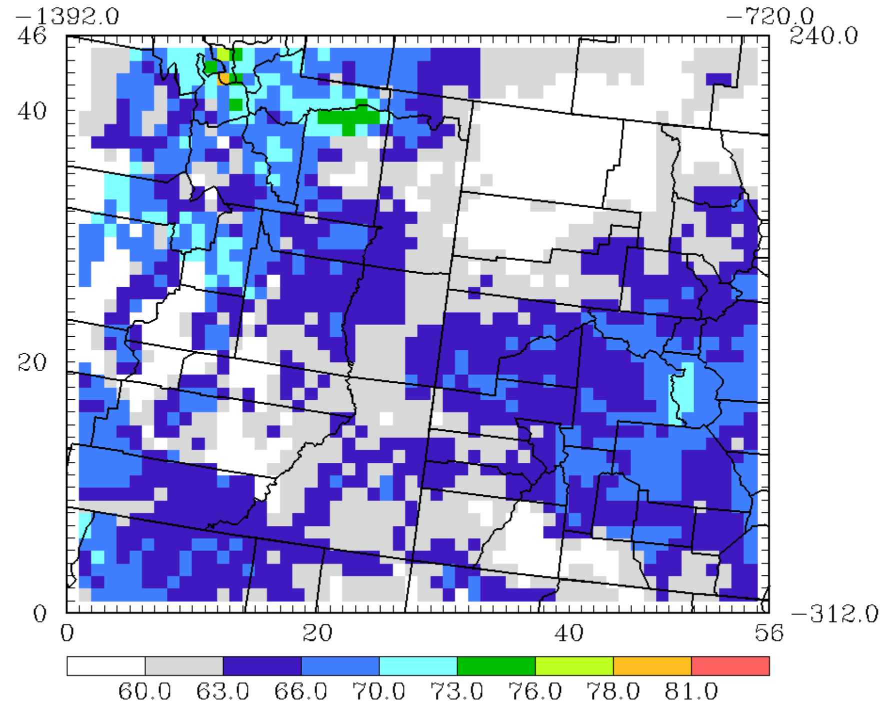


Figure 5-1: Baseline 8-hour Ozone Design Values

2005



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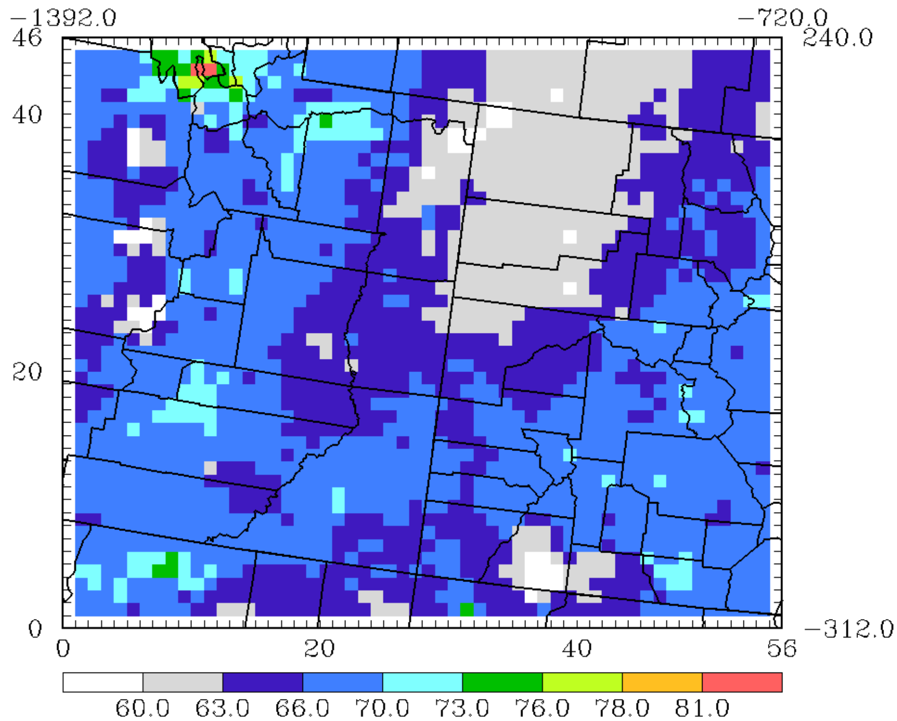
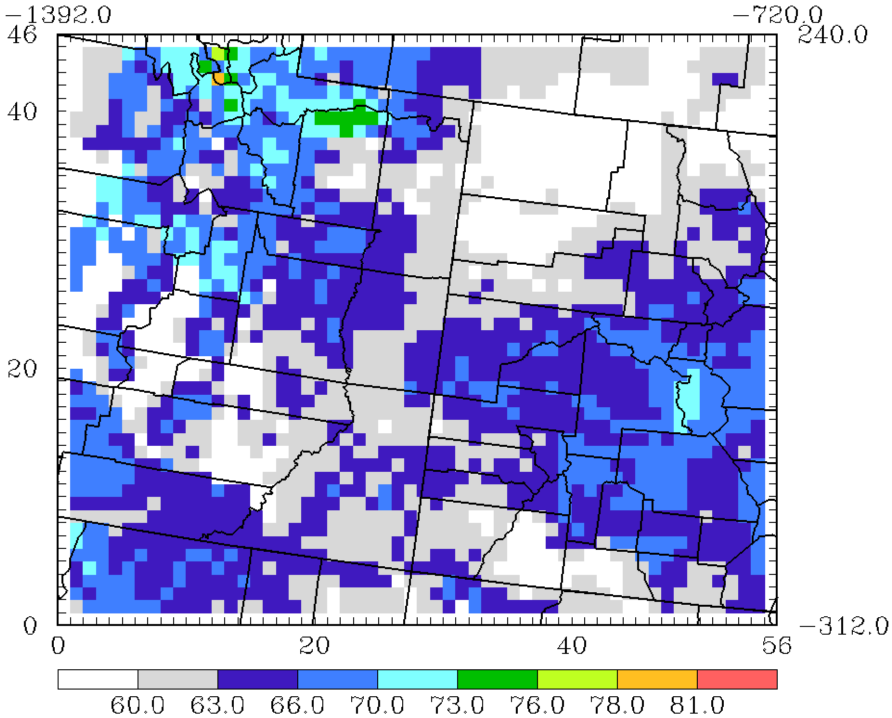


Figure 5-2: Annual 8-hour Ozone Future year Design Values for 2018 Future Year Base Case Projected Baseline with 70 ppb minimum threshold

2005



2006

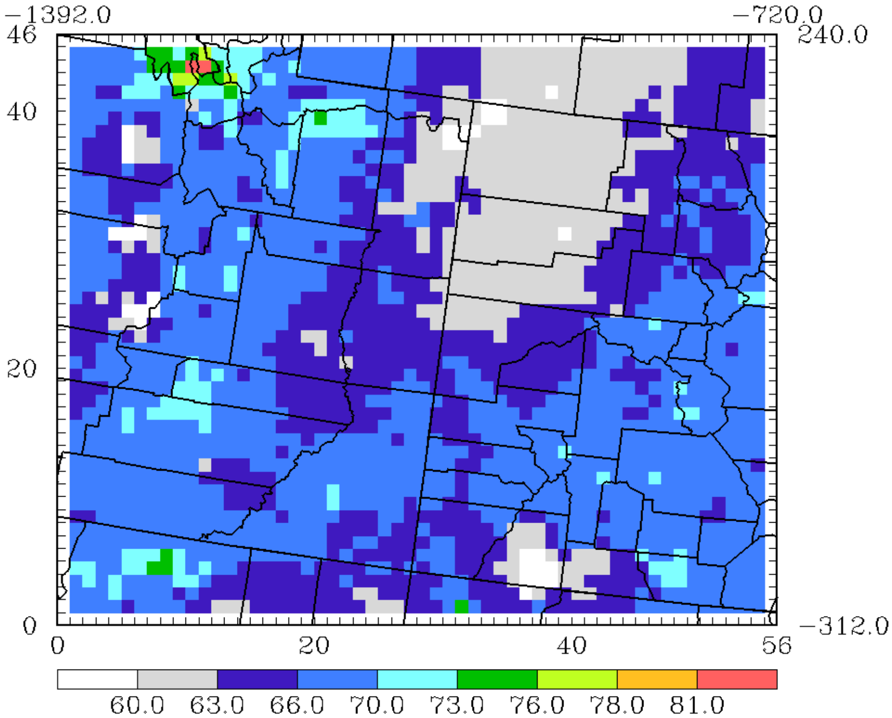
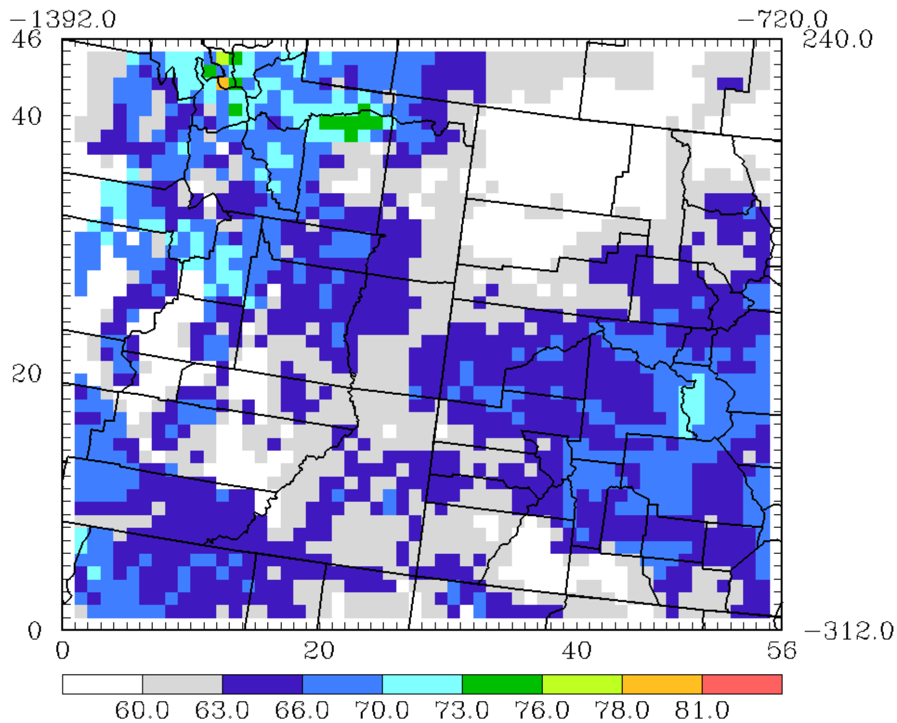


Figure 5-3: Annual 8-hour Ozone Future year Design Values for 2018 Proposed Action Projected Alternative with 70 ppb minimum threshold

2005



2006

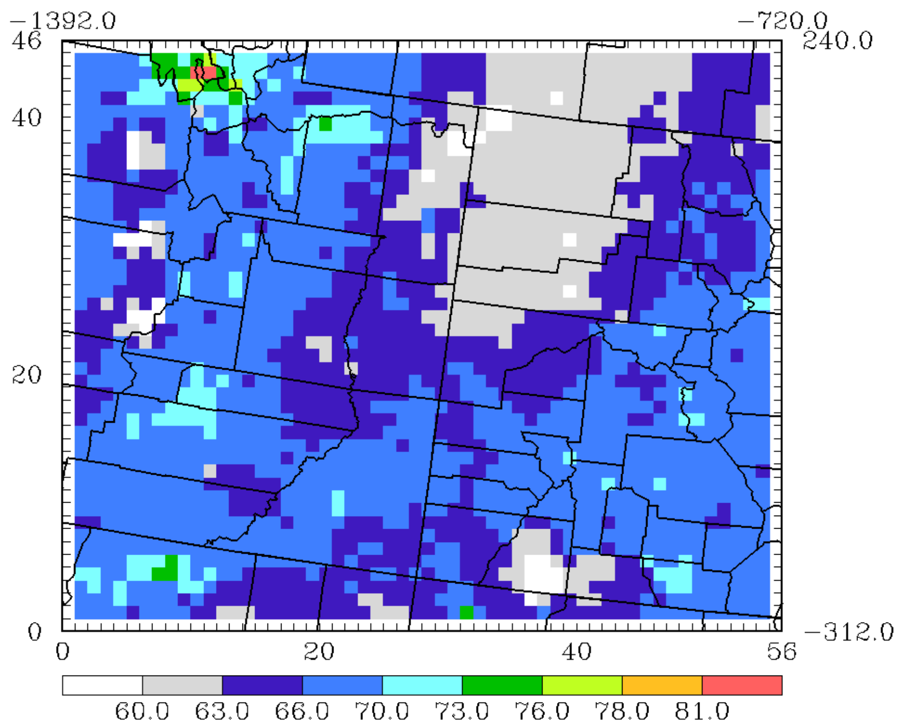
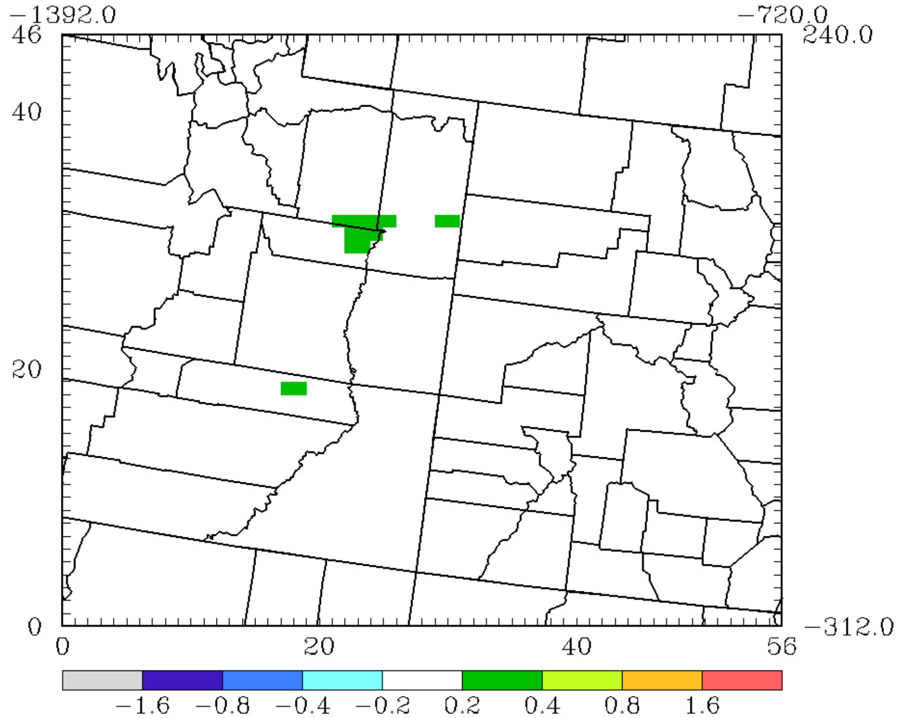


Figure 5-4: Annual 8-hour Ozone Future year Design Values for 2018 Proposed Action with ACEPMs Projected Alternative with 70 ppb minimum threshold

2005



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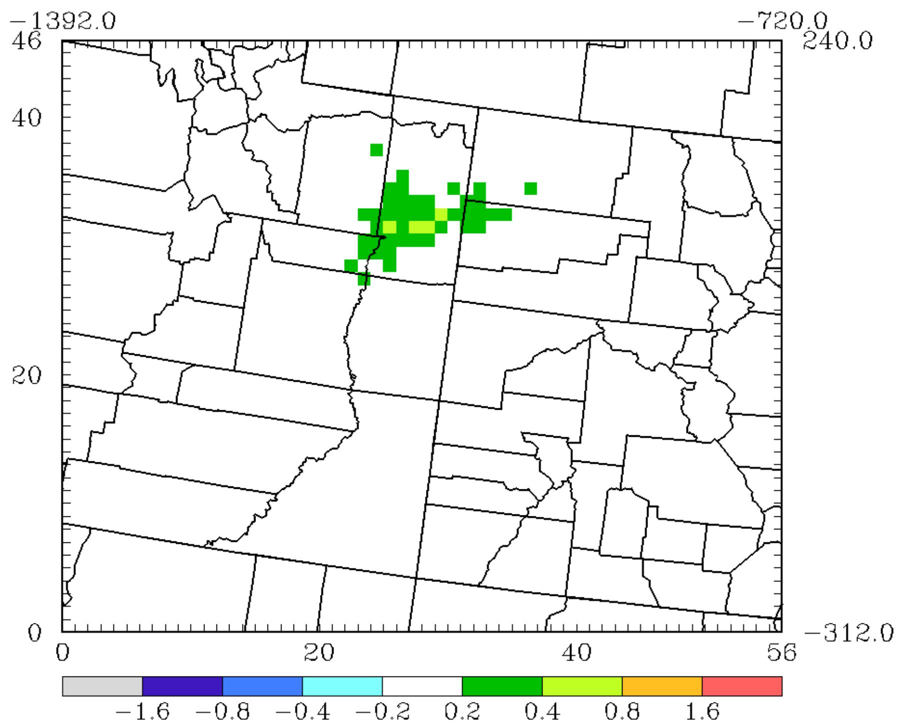
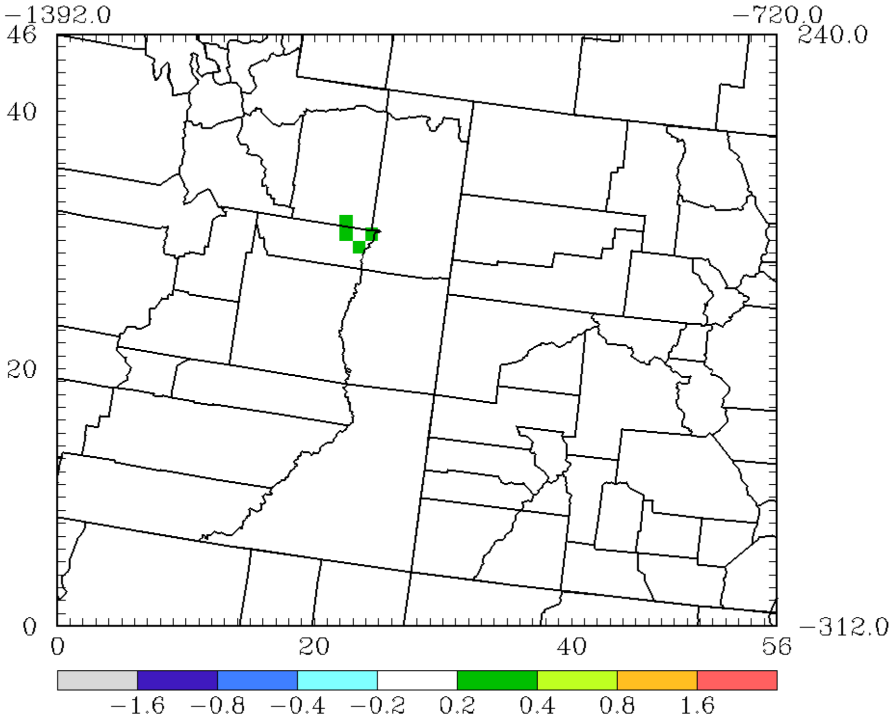


Figure 5-5: Annual 8-hour Ozone Future Design Value Differences for Proposed Action Minus 2018 Future Year Base Case with 70 ppb minimum threshold

2005



2006

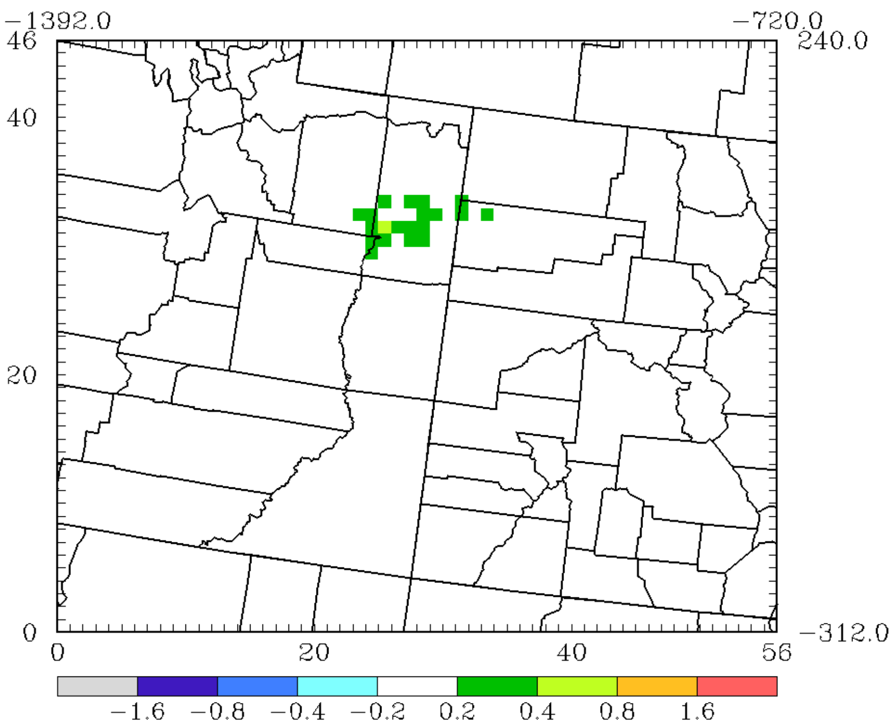
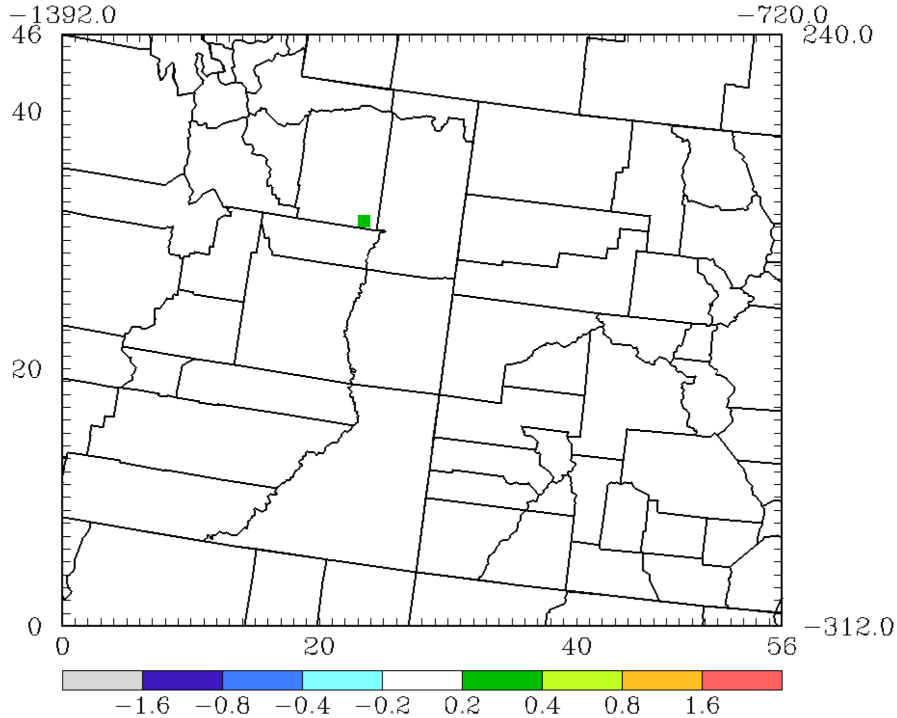


Figure 5-6: Annual 8-hour Ozone Future Design Value Differences for Proposed Action with ACEPMs Minus 2018 Future Year Base Case with 70 ppb minimum threshold

2005



2006

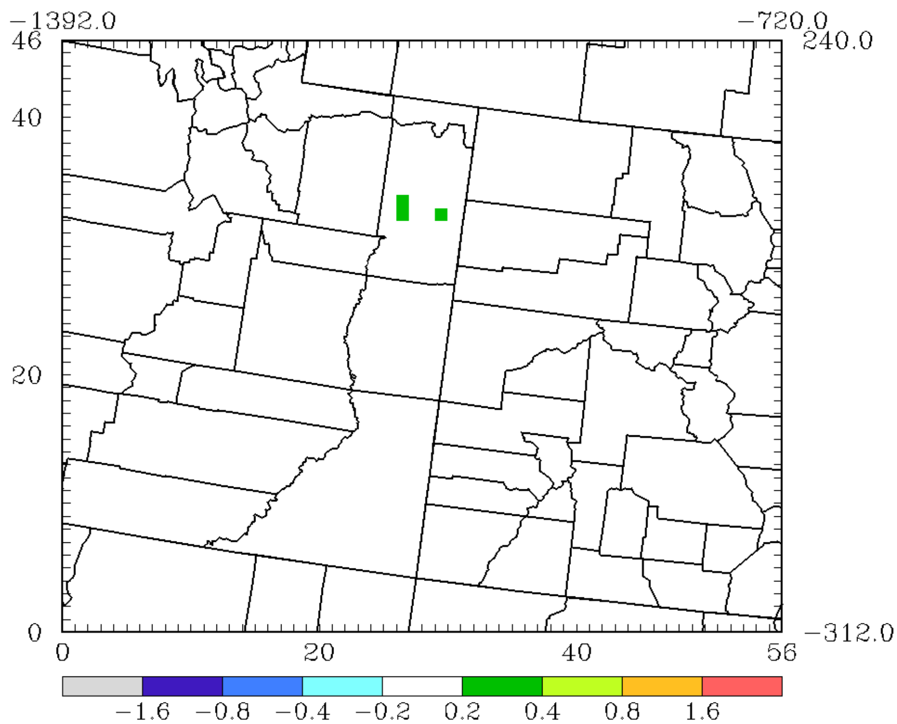
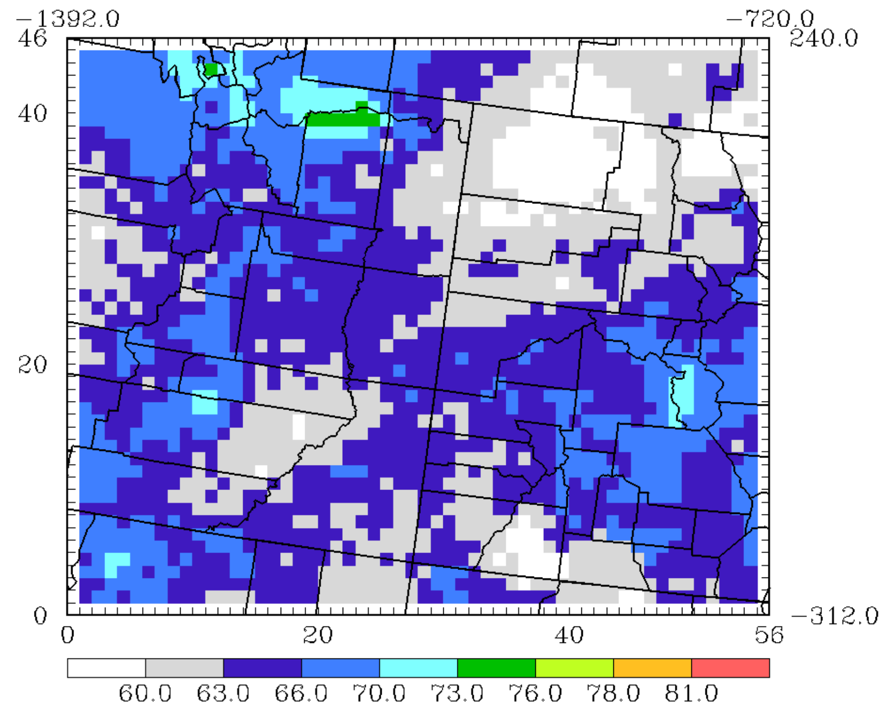


Figure 5-7: Annual 8-hour Ozone Future Design Value Differences for Proposed Action Minus Proposed Action with ACEPMs with 70 ppb minimum threshold

2005



2006

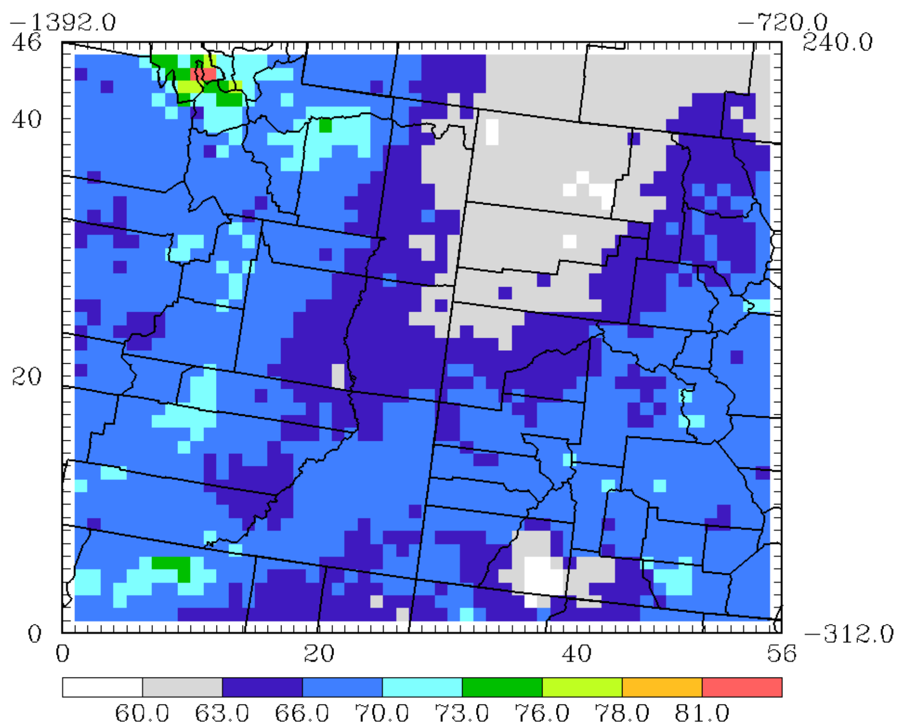
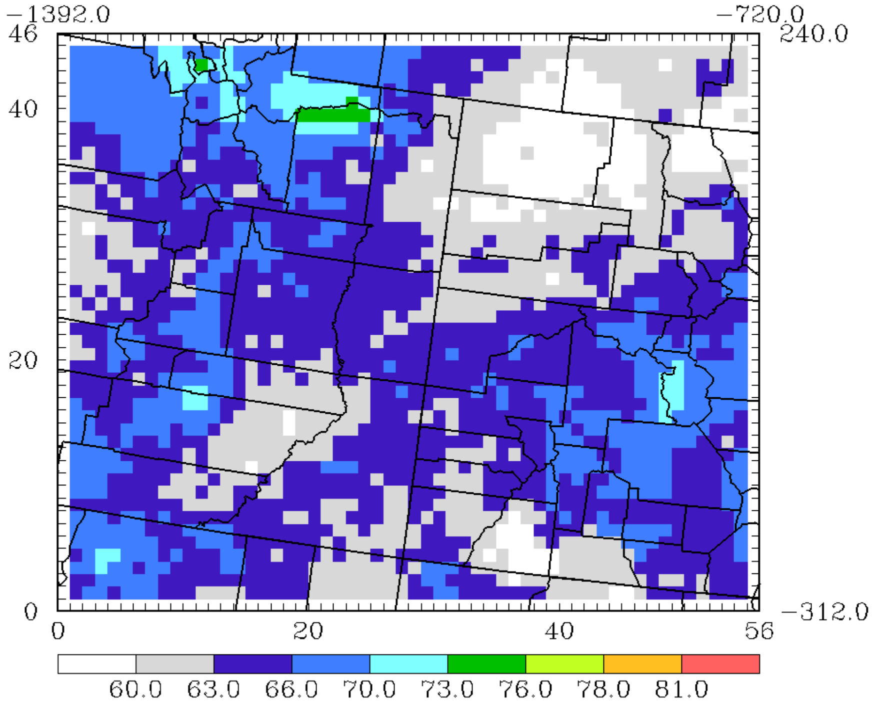


Figure 5-8: Annual 8-hour Ozone Future year Design Values for 2018 Future Year Base Case Projected Baseline with 60 ppb minimum threshold

2005



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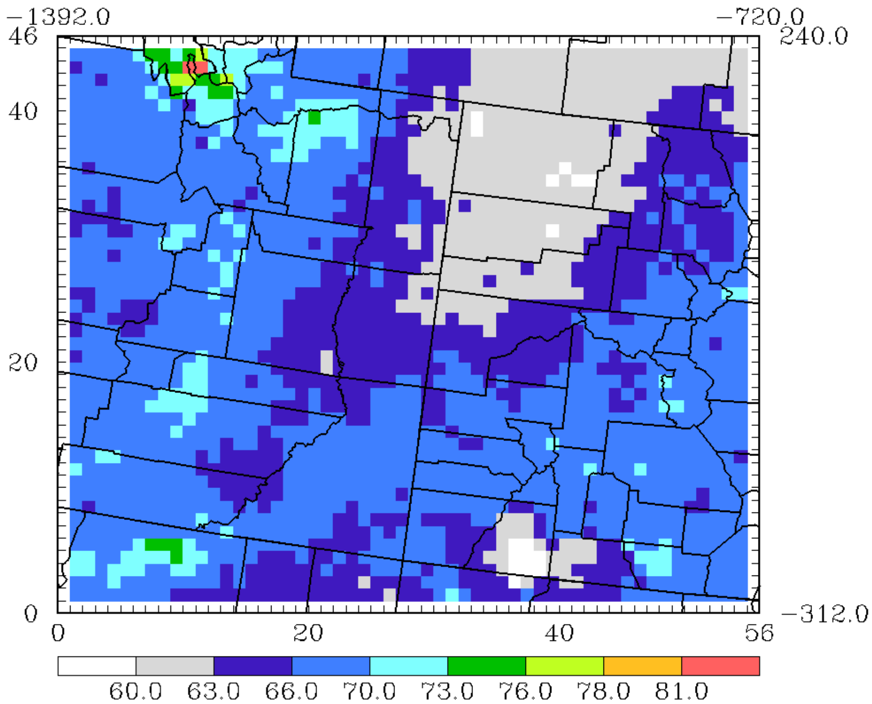
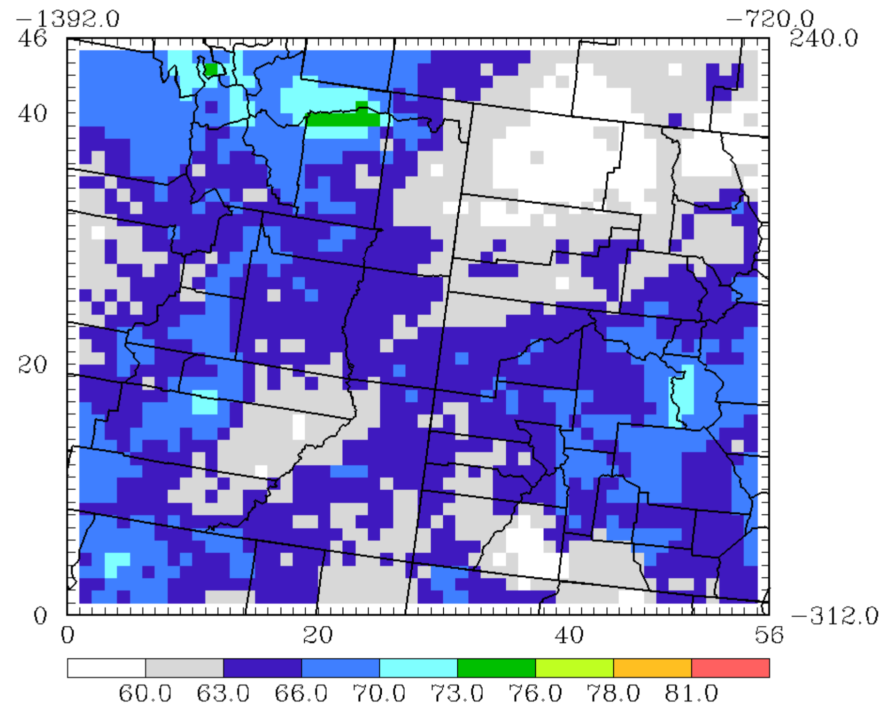


Figure 5-9: Annual 8-hour Ozone Future year Design Values for 2018 Proposed Action Projected Alternative with 60 ppb minimum threshold

2005



2006

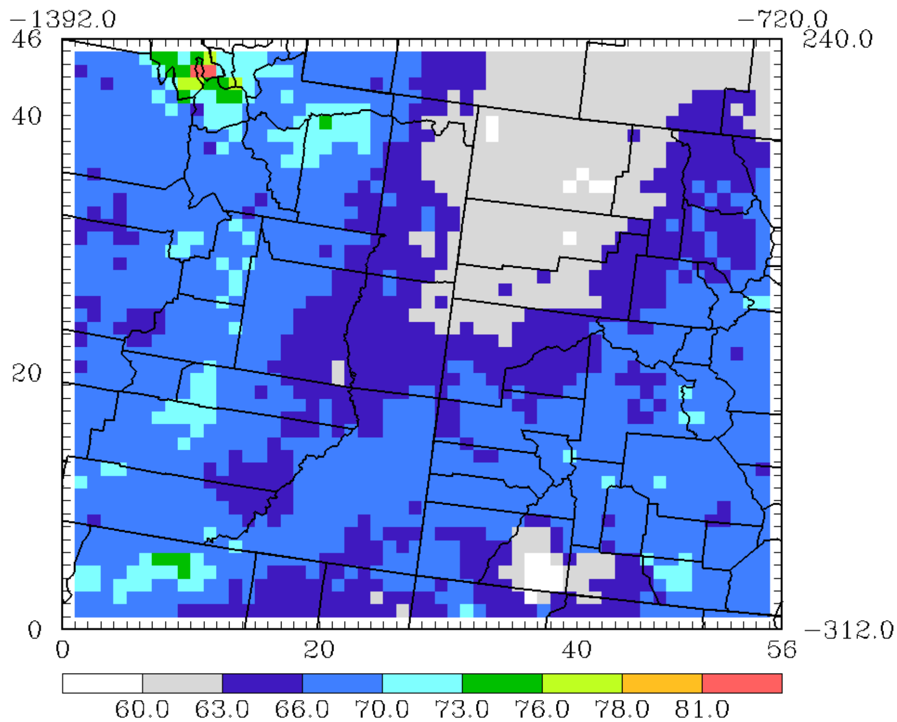
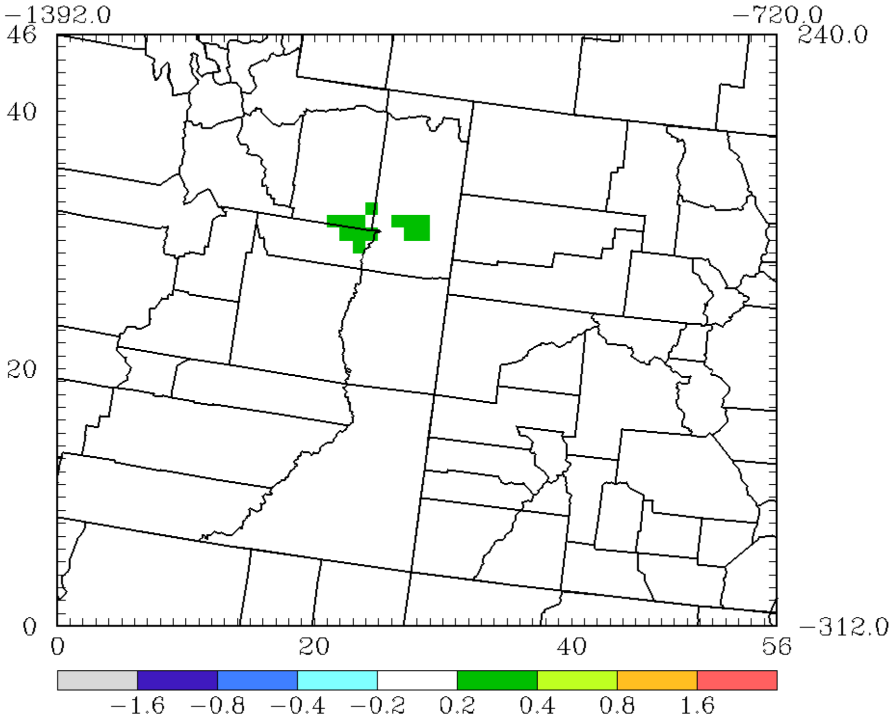


Figure 5-10: Annual 8-hour Ozone Future year Design Values for 2018 Proposed Action with ACEPMs Projected Alternative with 60 ppb minimum threshold

2005



2006

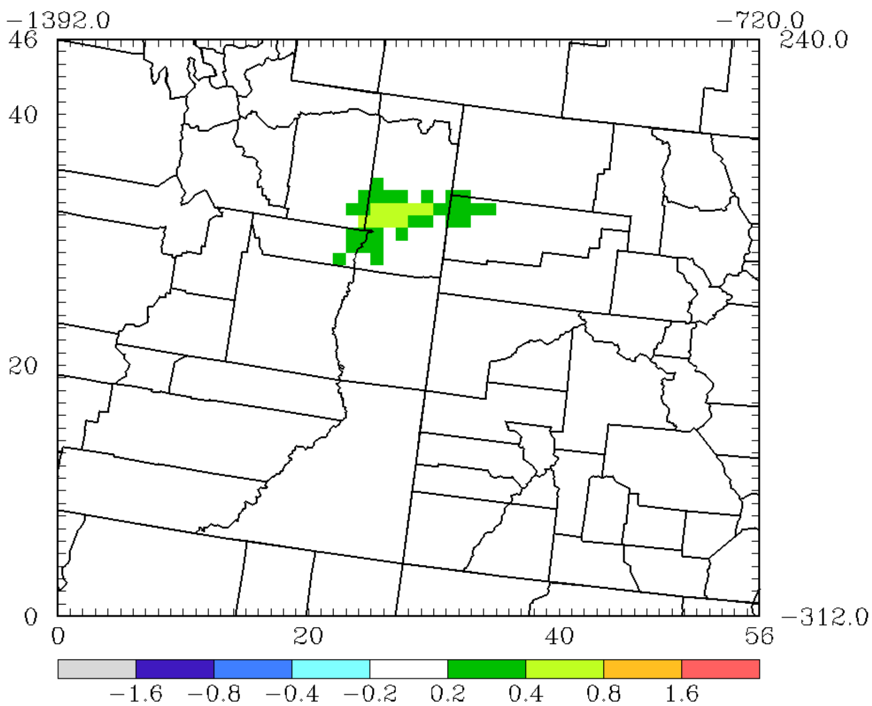
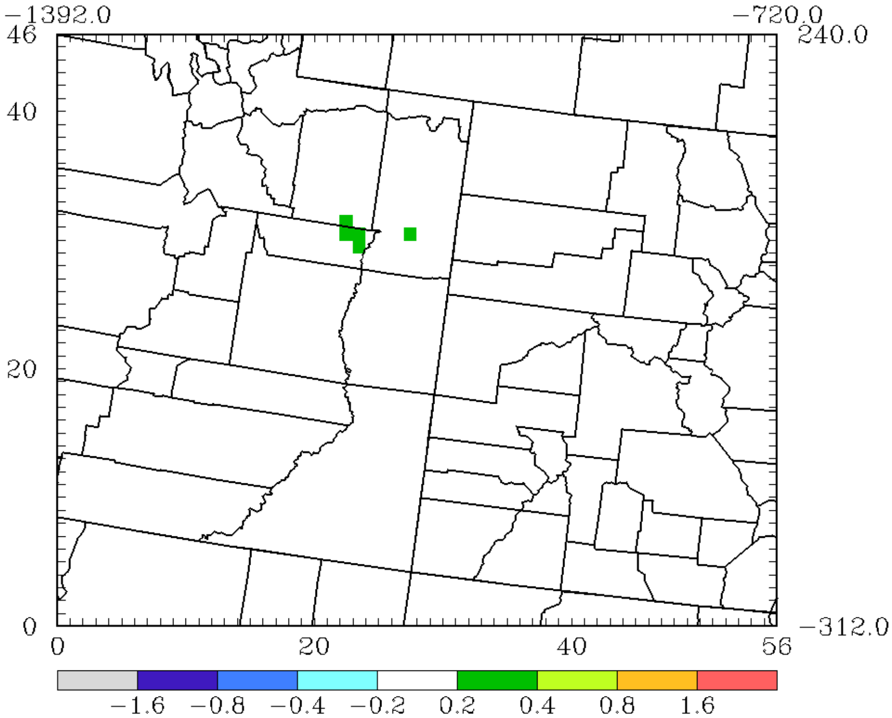


Figure 5-11: Annual 8-hour Ozone Future Design Value Differences for Proposed Action Minus 2018 Future Year Base Case with 60 ppb minimum threshold

2005



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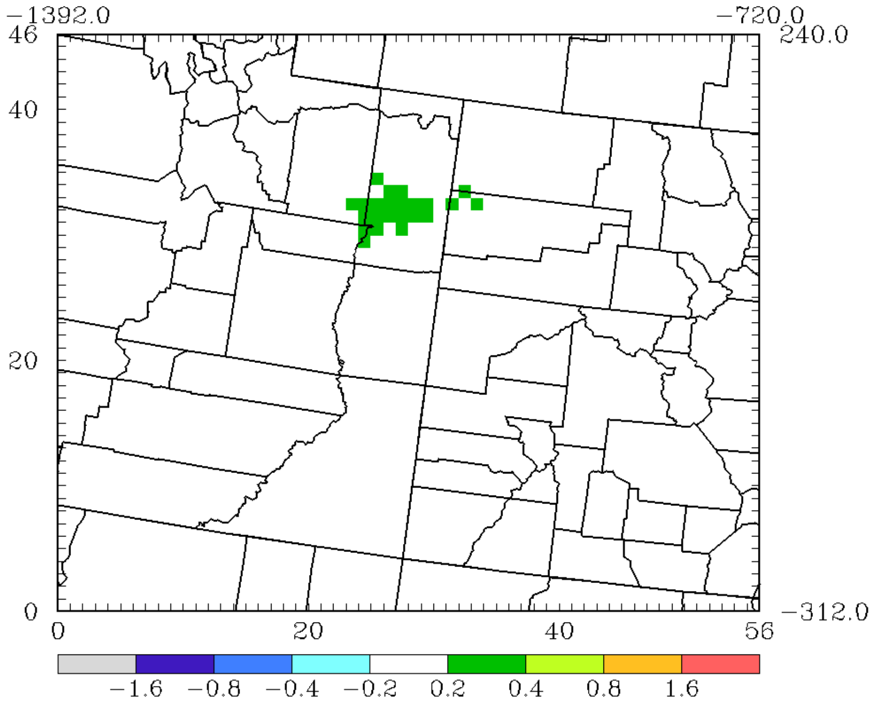
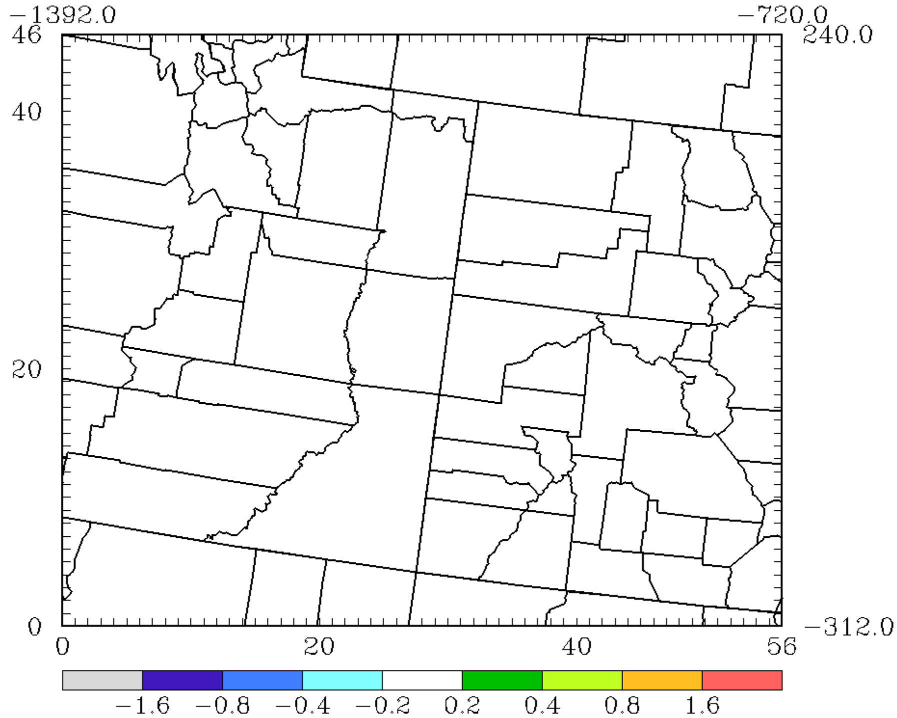


Figure 5-12: Annual 8-hour Ozone Future Design Value Differences for Proposed Action with ACEPMs Minus 2018 Future Year Base Case with 60 ppb minimum threshold

2005



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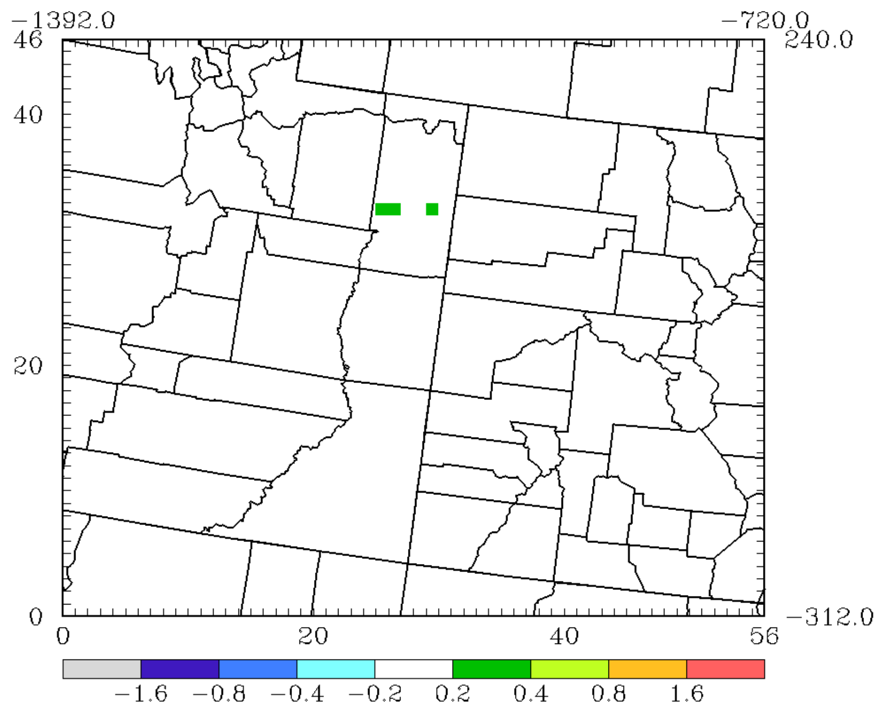
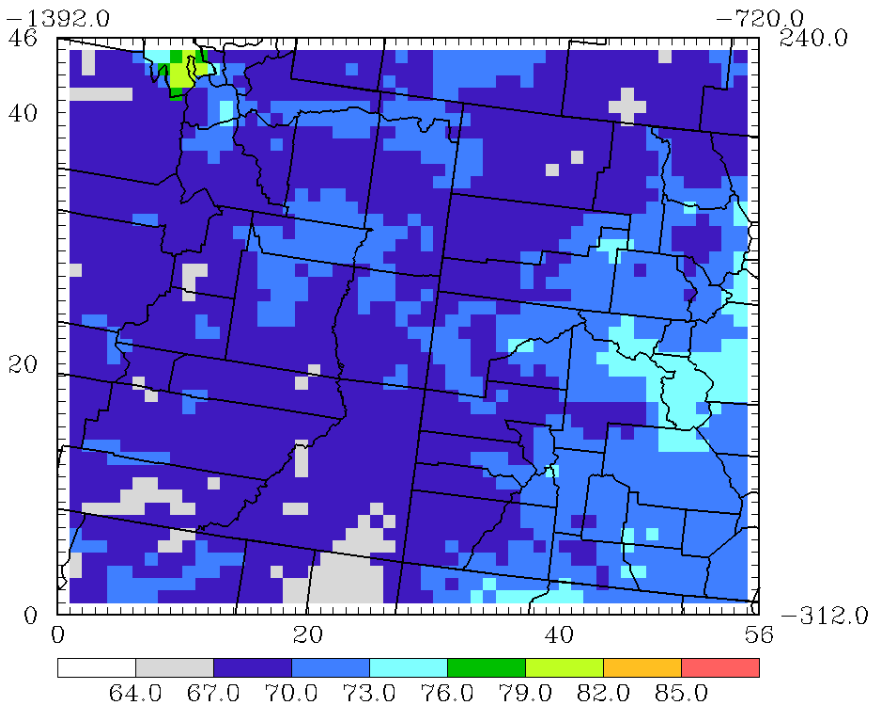


Figure 5-13: Annual 8-hour Ozone Future Design Value Differences for Proposed Action Minus Proposed Action with ACEPMs with 60 ppb minimum threshold

2005



2006

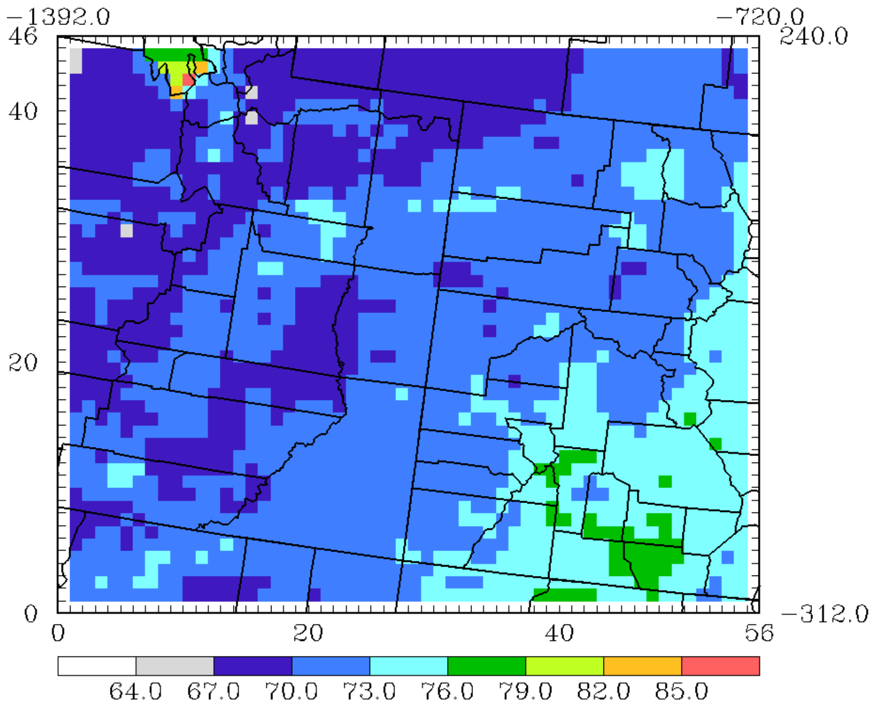
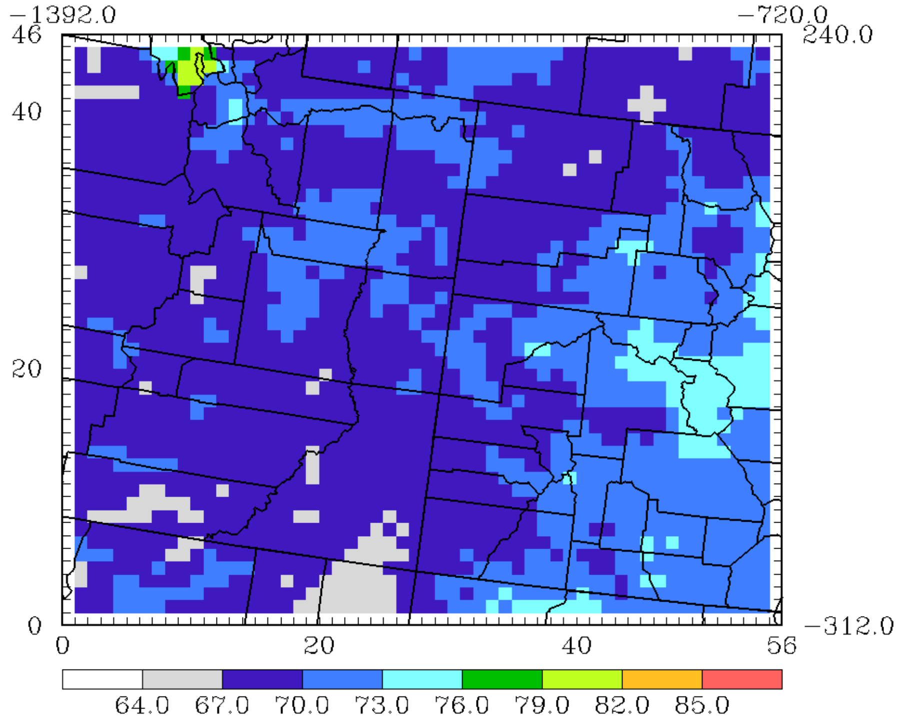


Figure 5-14: Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration for 2018 Future Year Base Case

2005



2006

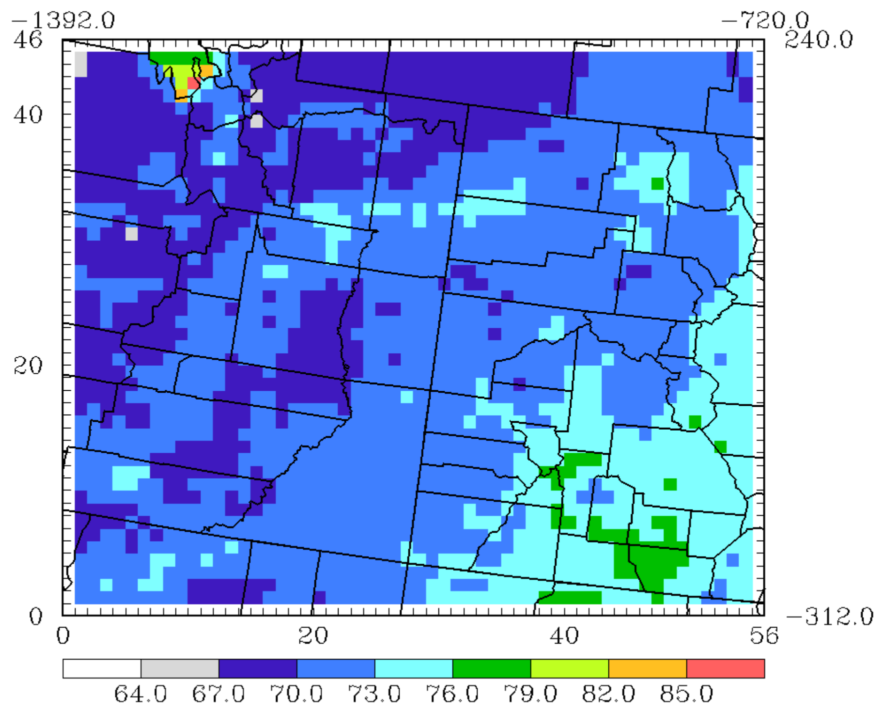
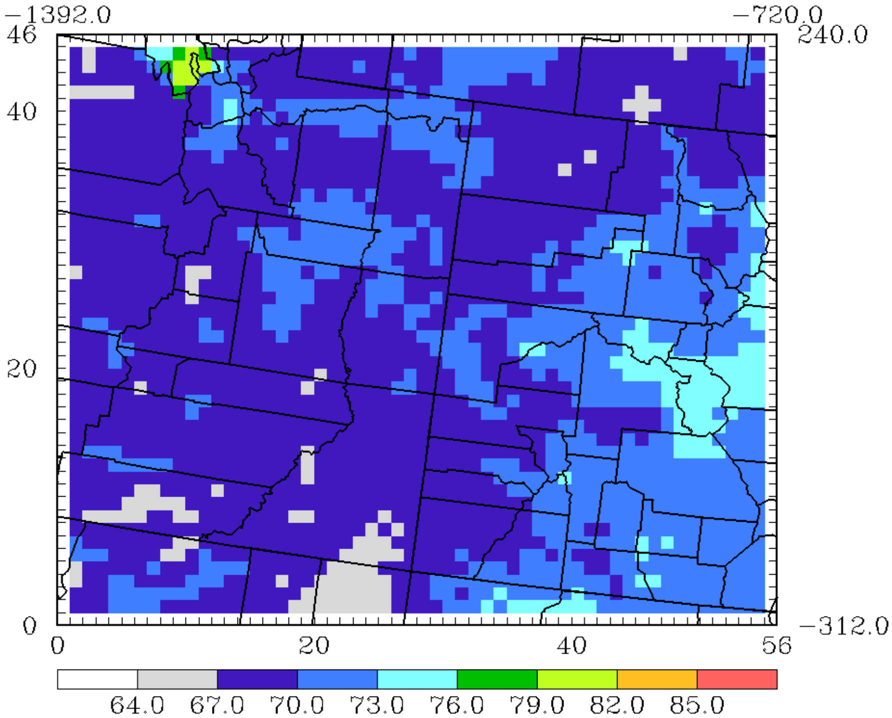


Figure 5-15: Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration for 2018 Proposed Action

2005



2006

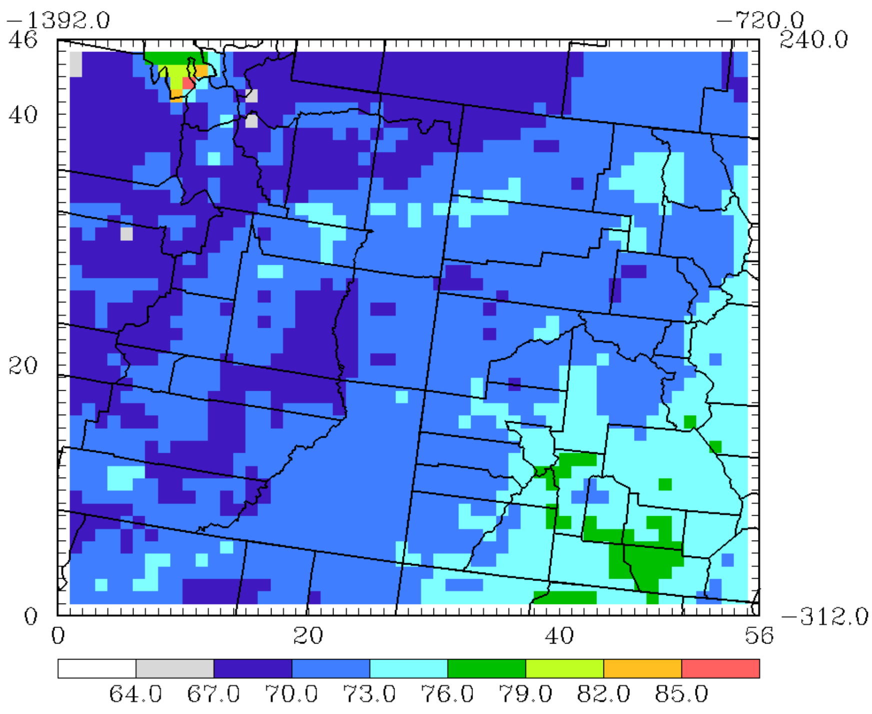
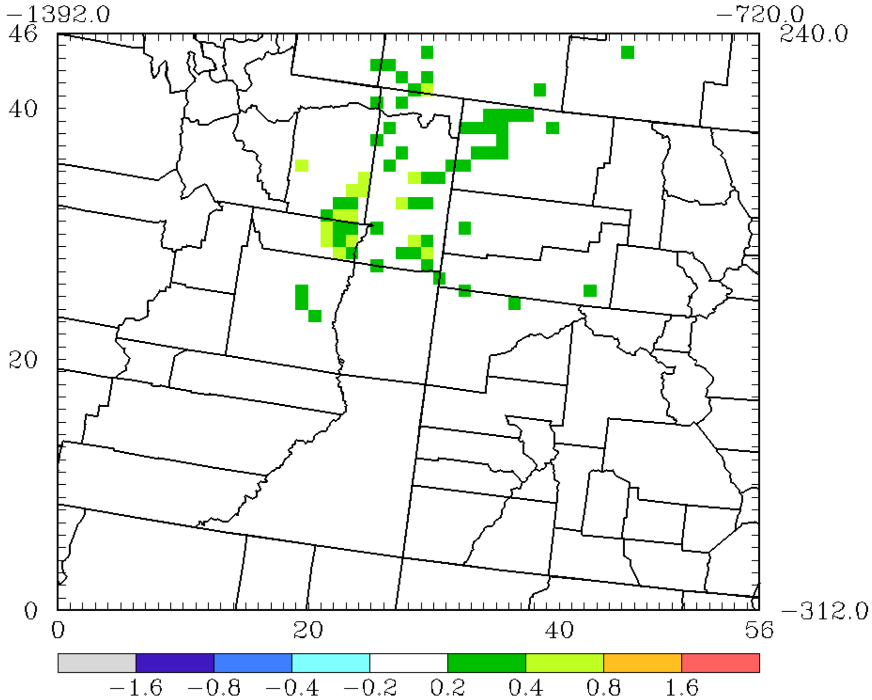


Figure 5-16: Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration for 2018 Proposed Action with ACEPMs

2005



2006

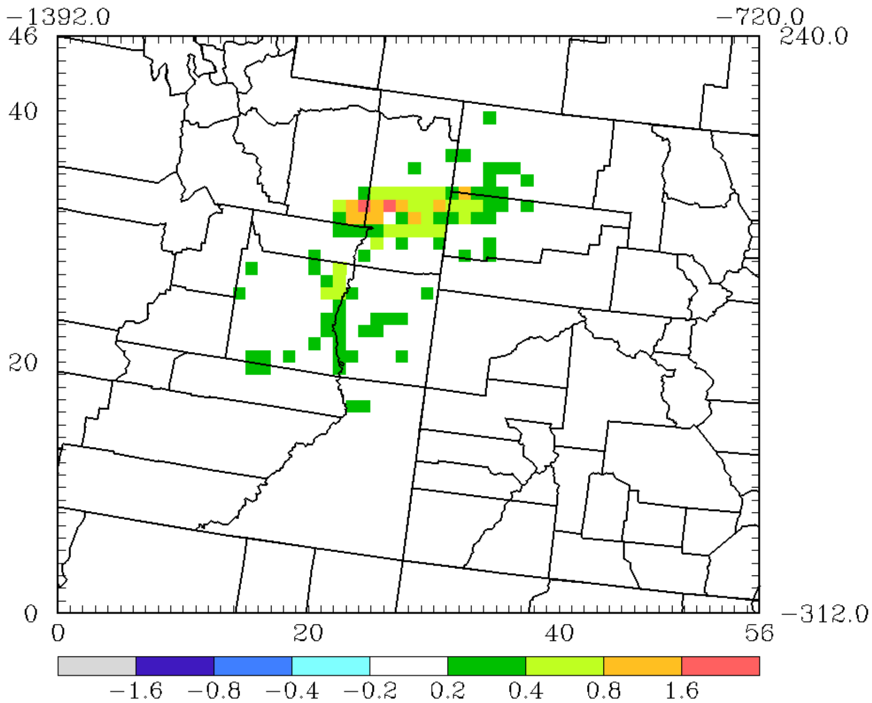
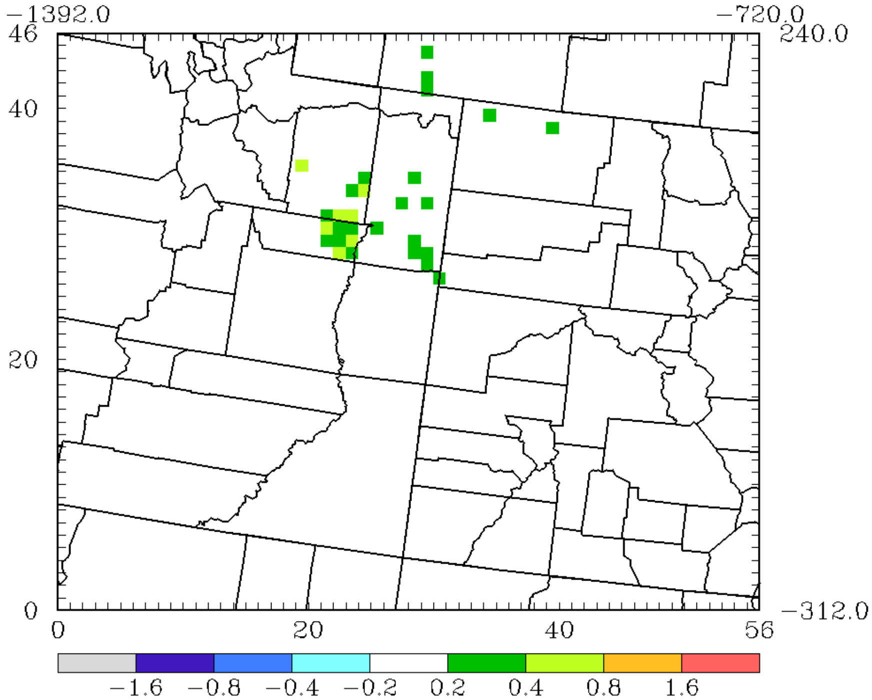


Figure 5-17: Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Future Year Base Case Minus 2018 Proposed Action

2005



2006

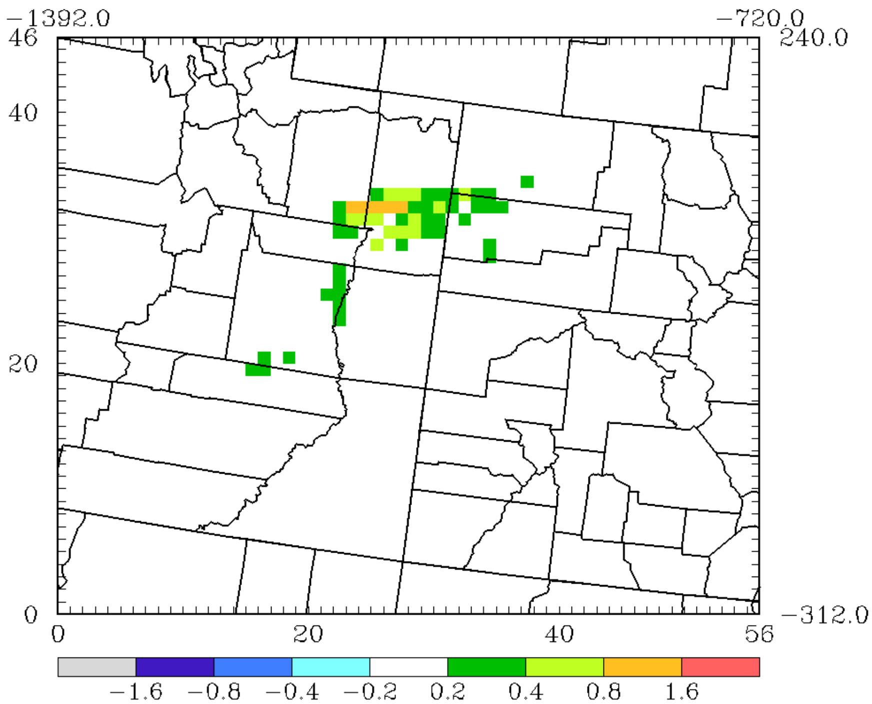
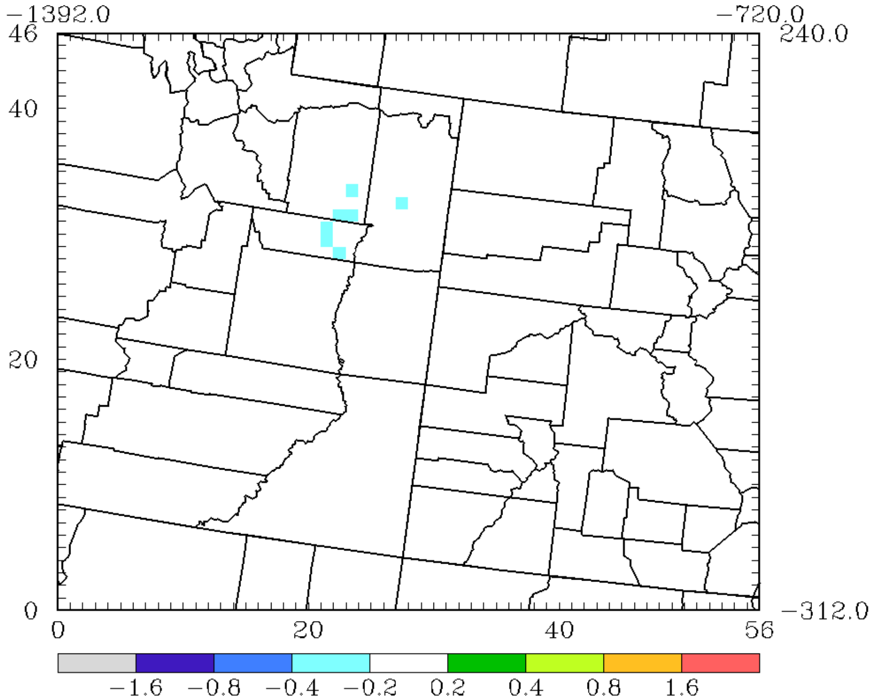


Figure 5-18: Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Future Year Base Case Minus 2018 Proposed Action with ACEPMs

2005



2006

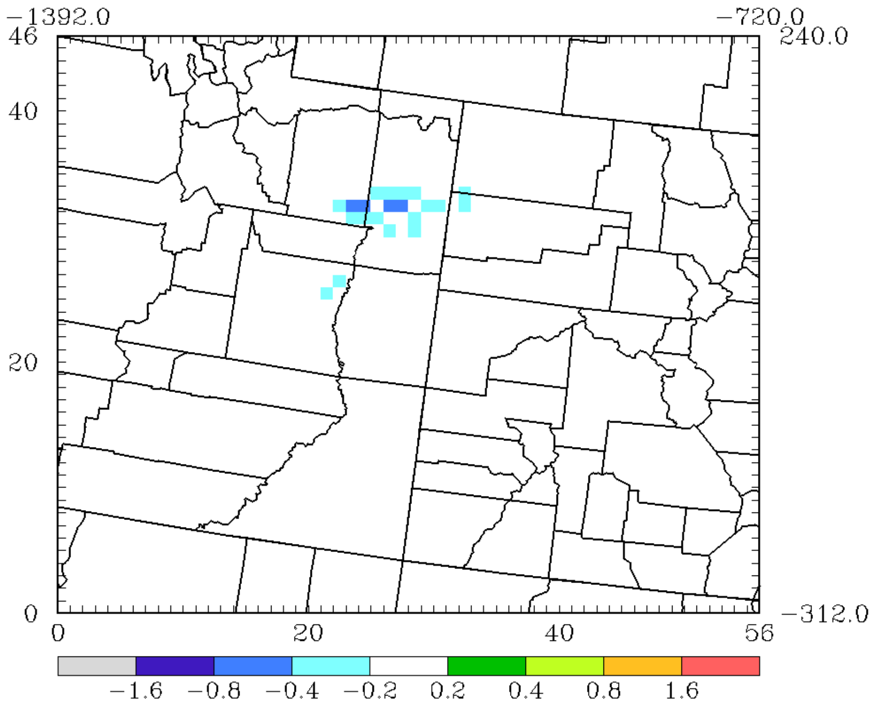


Figure 5-19: Difference in Fourth Highest Annual Daily Maximum Predicted 8-hour Ozone Concentration (ppb) for Proposed Action with ACEPMs Minus 2018 Proposed Action

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